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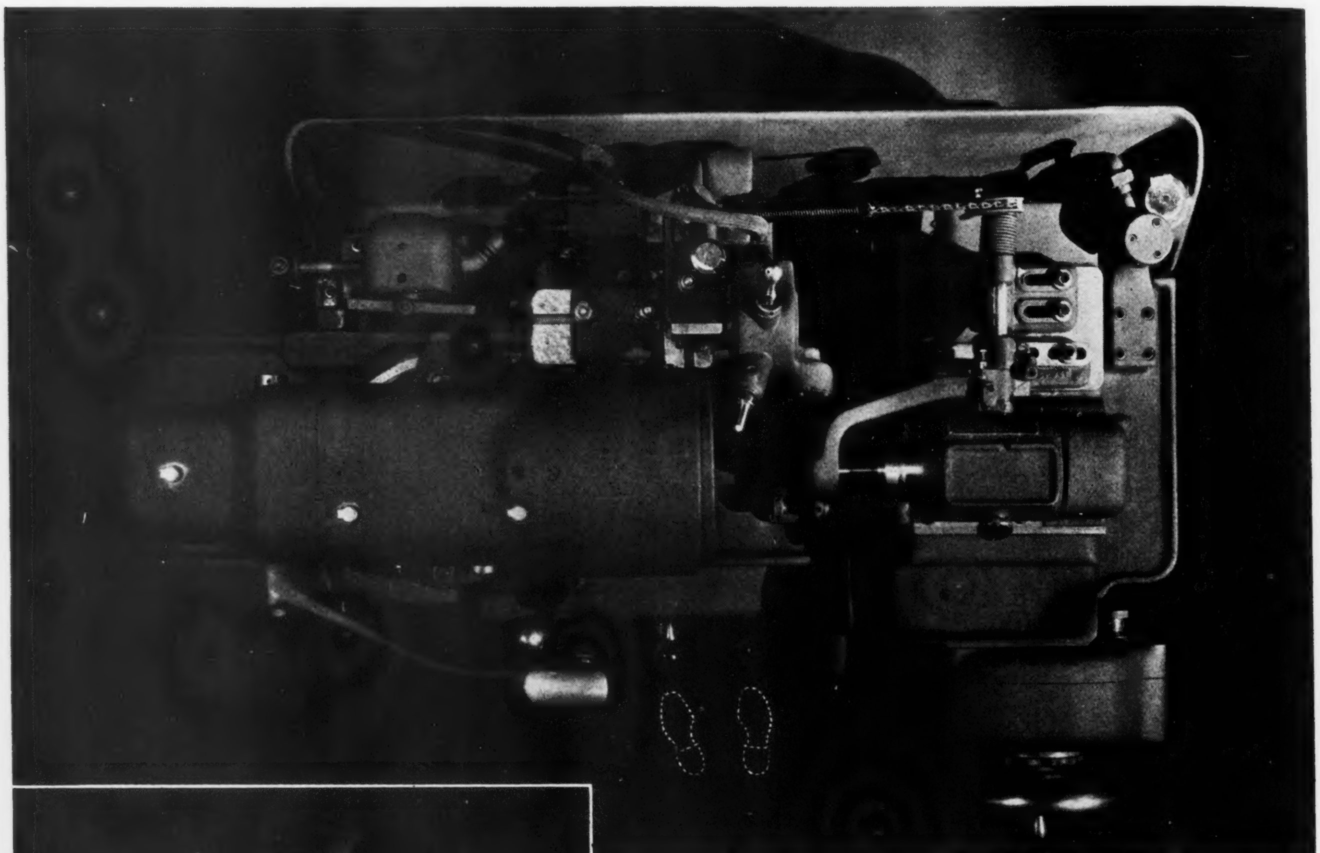

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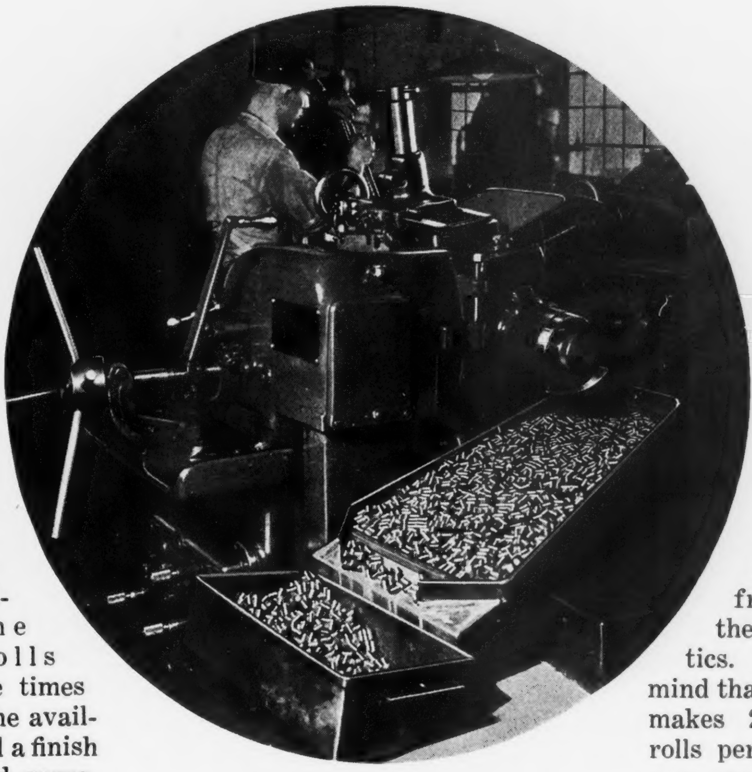
MACHINERY

Volume 38 NEW YORK, AUGUST, 1932 Number 12

Free-Wheeling Rolls Must Withstand Severe Shocks



By K. L. HERRMANN
Vice-President and General Manager
Bantam Ball Bearing Co., South Bend, Ind.

SOON after free-wheeling units were adopted for automobiles, the motor car manufacturers found that the standard rolls available on the market did not fully answer the severe requirements of the new application. Almost immediately the demand arose for rolls having at least three times the load capacity of the available standard rolls and a finish equal to that of lapped gages.

The high strength is necessary because of the heavy load which may be suddenly imposed on free-wheeling rolls by the cylindrical member or the cam member between which they operate, when the car speed and the motor speed are brought together. The free-wheeling rolls must be ductile enough to distribute this load throughout their sections. Another important requirement is that the rolls be of uniform hardness, because if one roll is even slightly harder than the others, the harder roll will fail.

The lapped finish was found necessary because of the high speeds that free-wheeling rolls attain—sometimes as high as 30,000 revolutions per minute. Even with the highest grade ground finish, the rolls would soon cut into the cam member and form a pocket that would make the free-wheeling mechanism fail to function satisfactorily. Lapping the rolls to give them a highly polished cylindrical surface has eliminated entirely that type of wear.

This article will outline the methods employed by the Bantam Ball Bearing Co. in making free-wheeling rolls with the required characteristics. It must be borne in mind that, while this company makes 25,000 free-wheeling rolls per day, the volume of any one size is too small to warrant continuous furnaces for heat-treating or automatic feeding devices for some of the other operations. For this reason, many operations must be done by hand methods.

The successful manufacture of free-wheeling rolls depends primarily, of course, upon the steel. The steel must be uniform as to analysis and structure so that it will respond to the same heat-treatment day after day. Chromium steel of S A E 52100 specification is used for the rolls. The chromium and carbon contents of this steel are such as to enable a high degree of hardness to be obtained.

The steel is received at the plant in the form of rolled rods, which have been ground at the mill to eliminate all surface decarburization. The rods are "spheroidized" prior to grinding. This process is a type of annealing that gives the steel a uniform

structure and causes uniform response to the hardening and tempering processes. This, in turn, produces uniform strength and eliminates the possibility of cracked or strained rolls.

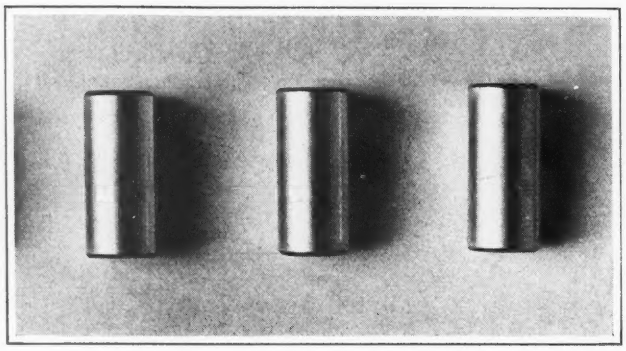


Fig. 1. Free-wheeling Rolls Such as are Used in Most Automobiles at the Present Time

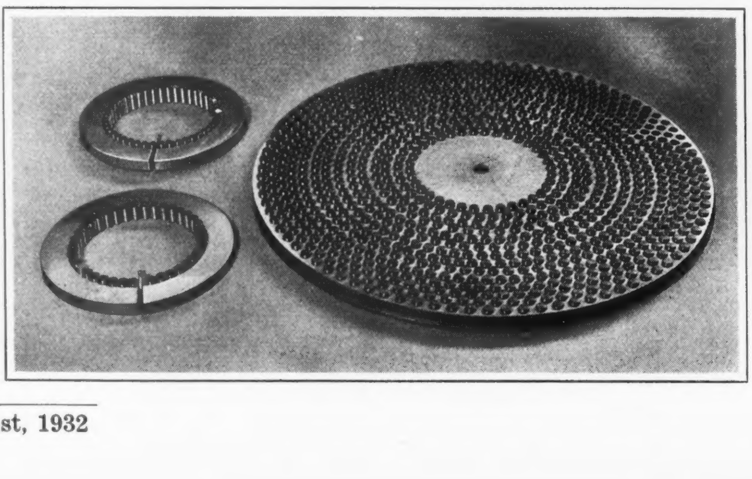
Spheroidizing, therefore, is an important step in the manufacture of free-wheeling rolls. Specifically, the process consists of heating the steel in a furnace for four hours at the usual normalizing temperature of 1460 degrees F., allowing it to cool rapidly to 1280 degrees F., then letting it cool at the rate of 5 degrees per hour in the furnace to 900 degrees F. (which requires about seventy-five hours), and finally permitting it to cool in air until room temperature is reached.

The first operation in the Bantam plant consists of cutting the stock into rolls, allowance being made for later grinding the rolls on both ends. Finished roll lengths range from 3/8 to 13/16 inch, and the nominal diameter from 5/16 to 1/2 inch. Larger rolls have been made for free-wheeling mechanisms, but the majority are within the sizes mentioned. The cutting off of the rolls from the rod stock is done in Gridley automatics, after which both ends of each roll are chamfered by coining the corners in a power press die.

Different Sizes of Rolls are Heated to Different Temperatures for Hardening

After the roll corners have been coined, the rolls are hardened in small batches, being placed in the furnace in baskets or pans. Rolls of different sizes are heat-treated separately, because each size requires a different temperature in order to attain the correct hardness. In this heat-treatment, "dead hardness" is avoided. Instead, a temperature is used that gives the rolls very nearly the hardness ultimately required. In the subsequent tempering operation they are drawn about two points only on the Rockwell C scale.

Fig. 2. Fixtures Employed in Grinding the Ends of Free-wheeling Rolls; the Large Plate Holds 980 Rolls



The temperatures at which the rolls are quenched vary about 10 degrees with each 1/16-inch difference in roll diameter. For instance, some of the 5/16-inch rolls are quenched at 1460 degrees F., while a 7/16-inch roll may need to be heated to 1480 degrees F. in order to give it the required hardness. The hardening is done by pouring the heated rolls into a squirrel-cage basket which is rocked back and forth in the quenching oil, a method that has been found especially satisfactory. The oil bath is kept at a constant temperature of about seventy-five degrees F. by means of a pipe coil through which cold water is passed.

By this heat-treating process, the rolls are given a hardness of from 60 to 62 on the Rockwell C scale. In the later tempering, they are drawn to from 57 to 59 on the C scale, the change never being more than three points.

In order to get uniformly hard rolls, it is necessary to use a furnace that will have a uniform temperature throughout. For this reason, the electric furnace that is used in the hardening process is provided with heating elements in the door and back, as well as all over the ceiling, sides, and floor. Also, the door is carefully fitted. With this construction, the temperature variation in the furnace is less than 10 degrees. It is automatically controlled and recorded by means of a standard instrument. The thermo-couple is checked daily for accuracy.

Two Tempering Operations are Performed

The rolls are tempered twice, immediately after the hardening and again after they have been ground cylindrically and on the ends. In both instances, the tempering is done in a General Electric air-tempering furnace which was modified to give more room above and below the heating elements. This increased the amount of air in circulation and has resulted in a uniform product. The drawing temperature varies slightly with the different sizes of rolls, but it is held close to 450 degrees F. The operation requires five hours.

The aim in hardening and tempering is to get the required hardness on the outside of the rolls and a gradual lessening of the hardness to the softer inner core without any sudden line of demarcation. In this way, internal strains are eliminated so that the rolls will stand up in service.

The Rolls are Ground on the Cylindrical Surface and on the Ends

After the hardening and the first tempering, the rolls are ground in centerless type machines, such as shown in the heading illustration. Roughing and finishing cuts are taken. About 0.010 inch of stock is removed from the rolls in the roughing cut, while 0.0015 inch of stock is removed in the finishing operation. On the roughing operation, the production averages 4500 rolls per hour, and on the finishing operation, 6000 rolls per hour.

As the rolls come from the finish grind, they are held to the specified size within plus or minus 0.00005 inch, which is a closer tolerance than is specified for the rolls after they are lapped. By grinding the rolls to this degree of accuracy, the subsequent lapping operation is simplified. In view of the fact that the rolls are lapped afterward, free-cutting wheels can be used for the grinding, with the result that the rolls are never "burned."

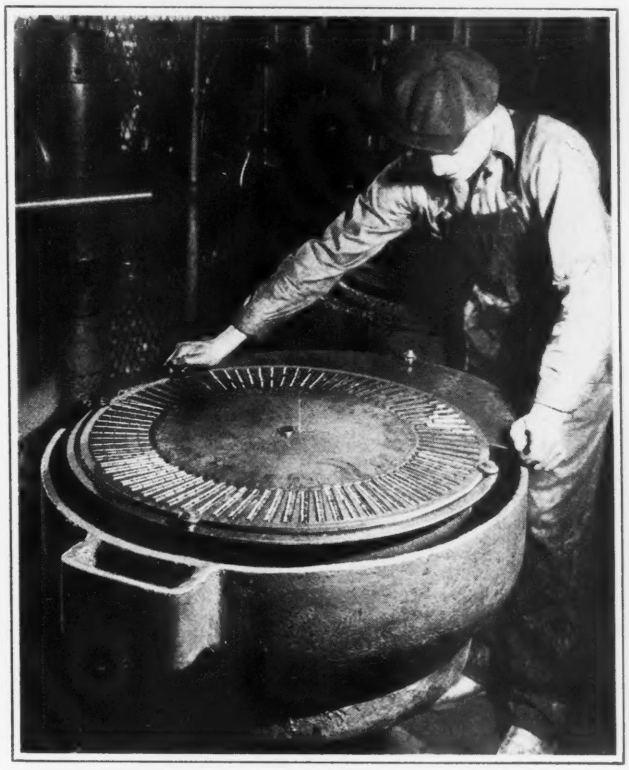


Fig. 3. All Free-wheeling Rolls are Lapped to Give Them the High Finish Necessary for Successful Service

After the centerless grinding operation, the ends of the rolls are ground on a Blanchard surface grinder. For this operation, the rolls are loaded either into large plates of the type seen at the right in Fig. 2, or into split rings of the design seen at the left. In loading the large plate, a sheet-steel disk is first placed beneath the plate so that the rolls cannot fall through the holes when the plate is transferred to the magnetic chuck of the surface grinder. After the rolls have been ground on one end, a similar sheet-metal disk is clamped over the exposed ends and then the plate is turned over for grinding the opposite end. Nine hundred and eighty rolls can be held in this plate at one time. It takes from fifteen to twenty minutes to load them.

Before loading one of the split rings, a wedge is inserted between the ends of the ring. When this wedge is removed, the ring contracts and grips the rolls firmly.

After the rolls have been ground all over, they are put through the second tempering process for a period of five hours.

As the roll ends have received their final finish prior to this tempering, the process leaves its telltale mark on the ends, even after the customer receives them. This gives double assurance that the rolls have been tempered, and the color of the ends gives an idea of the temperature from which they were drawn.

Each lot of rolls is tested for resistance to breakage, both after the hardening process and after the second tempering. This breakage test consists of dropping a 20-pound weight on a roll from various heights, depending upon the roll size. The roll is held in a fixture and the weight drops in a tube.

In testing a roll, say, 0.333 inch in diameter by 0.740 inch long, the weight would be raised to a point where 100 foot-pounds would be obtained for the first drop. Then, for the second drop, the weight would be raised to a height that would give 110 foot-pounds; for the third drop, to a height that would give 120 foot-pounds; and for the fourth drop, to a height that would give 130 foot-pounds. The size of roll mentioned would at least have to take, without breaking, the third drop of 120 foot-pounds. Other sizes of rolls must meet corresponding specifications.

A Microscope is Used for Checking the Lapped Finish

Following the final drawing operation, each roll is inspected for size and hardness. The rolls are then ready to be lapped in machines of the type shown in Fig. 3, which remove any minute unevenness and give the high polish that is necessary for successful service. In the lapping operation, the rolls are rotated through contact with two large revolving lapping wheels, one above the rolls and the other below. The operation requires seven minutes.

An important point in lapping is that the compound must be maintained at a certain consistency

in order to obtain uniform results. The slotted plate that holds the rolls between the lapping wheels is loaded on a bench with a split sheet-steel ring clamped to the under side to prevent the rolls from falling through while being transferred to the lapping machine. After the slotted plate has been placed on the lapping machine, these split sheet-steel rings are removed in the manner shown. The compound used for lapping consists of silicon carbide.

At the end of the lapping operation, the rolls are tumbled in sawdust to clean them thoroughly of all lapping compound and dirt.

Fig. 4 shows a general view of the inspection bench. On the far side are three girls who test the rolls for hardness in Rockwell machines. The anvil on each machine is foot-operated, and this enables each girl to check approximately 1000 rolls per hour. A rod fastened to one of the anvil arms connects the anvil to a lever that is swung back and forth on its pivot by the right foot of the inspector. In this way, the anvil can be quickly raised and lowered while the inspector moves the lever on the head of the machine with her right hand to operate the plunger and slips rolls into place with her left hand.

The microscope in the foreground, which has a magnification of 25 diameters, is used for observing the lapped finish on a certain number of rolls from each batch. The rolls are also given a 100 per cent visual inspection by rolling them over a ground glass, illuminated uniformly by an overhead light.

The diameter of the rolls is checked by means of a snap gage, the tolerance being plus or minus 0.0001 inch. This tolerance is greater than that allowed at the end of the finish-grinding, a fact which has already been referred to. When the rolls have passed the final inspection, they go to the girl at the extreme right in the illustration, who sprays paraffin oil on them to prevent rusting during storage and shipment. The rolls are then laid end for end on strips of paper, wrapped, and placed in boxes.

A feature of the inspection bench is that the work at each point progresses from left to right. In any position, the pan at the left of the inspector holds work that has not yet been checked, while the pan at the right contains rolls that have passed the inspection. Rolls that are defective are dropped into pans at the left back corner of the bench. By paying the strictest attention to this routine, there is no chance of mixing inspected rolls with rejected or uninspected ones.

Difficulties Encountered when Rolls Have Not Been Given Proper Heat-Treatment

When free-wheeling rolls fail in service, it is invariably due to improper heat-treatment. In this connection, it is of interest to study three such failures which are shown in Fig. 5. Example *A* is a roll that had a microscopic fissure as a result of being hardened at a temperature that produced "dead hardness." The half-moon fracture that developed apparently shows that the outer layers of the roll cooled too rapidly in comparison with the core during the hardening process, causing a shrinkage of the outer layers which produced a strain similar to that which occurs when an ingot is cooled too fast. In such a case, the strain extends along the center of the roll only and not to the ends.

Fig. 4. General View of the Inspection Bench at which the Free-wheeling Rolls are Given the Final Check for Finish, Hardness, and Size

The broken roll halves at *B* illustrate a case where the outside of a roll withstood all the strain occurring during cooling, but having become set, it did not contract when the core passed through the critical temperature. This created a diametrical core strain which resulted in the roll breaking in two.

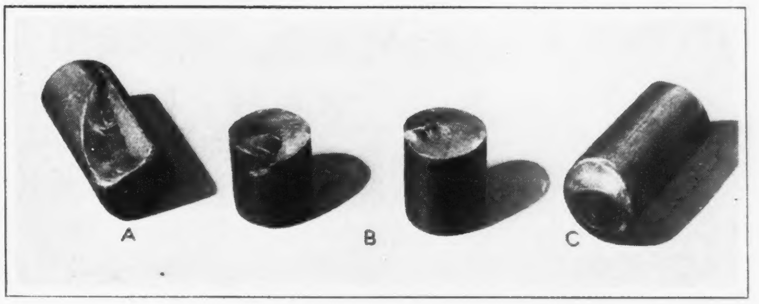


Fig. 5. Several Free-wheeling Rolls that Failed in Service Due to Improper Hardening

A third type of common roll failure is shown by example *C*. One corner of this roll became chipped off in service as a result of the core pulling away from the corner of the roll as it cooled during quenching, after quenching, or even after tempering.

Failures such as those pointed out do not occur if the rolls are not made too hard to start with.

* * *

The Correct Use of the Word "Stamping"

By CHARLES DOESCHER

From time to time the writer has noticed in various trade papers what seems to be a most misleading use of the world "stamping." For example, on page 616 of April MACHINERY is an article entitled "Stampings Produced Rapidly and Economically in Lots of 100." In connection with this article is shown a cut with a caption which reads "Typical Stampings Made Economically in Lots as Small as One Hundred." This illustration shows four different shaped pieces which are called stampings. Now these pieces are not stampings; they are just ordinary blanks that are cut from flat sheet stock by a set of blanking tools.

The term "stamping" should be applied only to sheet-metal articles that have actually been stamped; that is, indented or formed by a stamping punch and a stamping die, either before or after the article has been blanked from flat stock. On the other hand, when the term "blank" is used, we understand that it designates regular or irregular shaped articles that have been cut, not stamped, from flat stock.

* * *

Westinghouse Receives a Big Contract

A contract calling for the manufacture of equipment to a value of $1,750,000 has been awarded the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., by the Philadelphia Electric Co. This is part of an electrical project calling for the expenditure of $8,500,000 by the Philadelphia concern in the next two years. The contract covers a 183,000-kv-a. turbine generator and is one of the largest contracts awarded for generating equipment in several years. About two years will be required to complete the installation.

It is not without significance that a large public utility like the Philadelphia Electric Co. should have selected the present time for adding a plant of such huge proportions to its generating capacity. Evidently, the management of this company entertains no doubts as to the future; and it is quite likely that other large electric public service companies may conclude that there are equally strong reasons for them to proceed with additions to their capacity at the present time, when the conditions for doing so from a cost point of view are unusually favorable.

* * *

How to Preserve Stored Rubber Belts

It is essential that rubber belting be protected from deterioration during shutdown periods, if economical operation is to be expected later. After an exhaustive study on the storage of rubber products, the B. F. Goodrich Co., Akron, Ohio, states that rubber belts should be stored in a dark cool place (the temperature should not be over 70 degrees F.) that is not too dry. Direct sunlight and warm air should be avoided wherever possible.

To further protect belting in storage, the following solution may be used to treat the edges and exposed faces of belts in rolls: One quart of shellac; one pint of alcohol; one and one-half quarts of household ammonia; and three quarts of water. This solution can be quickly applied with a whitewash brush. One gallon should cover about 300 square feet. It can be purchased already mixed, combined with special age-resisting chemicals. When the shutdown period is not of sufficient duration to require that the belts be taken off and rolled up, it is suggested that the installation be inspected to make certain that the tension has been relieved.

* * *

Diesel engines, as applied to tractors, form the subject of a paper recently read by C. G. A. Rosen of the Caterpillar Tractor Co. before the Agricultural Engineers' Club at Davis, Calif. The Caterpillar Tractor Co. has conducted a great deal of research work pertaining to the application of Diesel engines to tractors, and has been very successful in developing a Diesel engine for this service.

A Group Piece-Work System that Pleases Everybody

Both Company and Men Profit by Effective Teamwork, Promoted by a System that Develops the Initiative and Responsibility of Each Individual

By B. C. BOOTH
Superintendent Radio Division, Brunswick Radio Corporation, Muskegon, Mich.

LAST year we tried a group piece-work system on some sub-assembly jobs with sufficient success to warrant its application to all our manufacturing operations this year. It has proved a money-saver in our factory, where the operations are of a seasonal nature. There are three types of application for the group piece-work system—namely, in sub-assembly and final assembly departments which assemble a complete unit; in departments where all machining, plating, etc., as well as assembling are done and paid for on the basis of the number of complete units produced; and in departments such as the automatic screw machine, punch press, or general machine shop, where many different parts are produced and paid for according to the number of individual pieces produced.

Application to Sub- and Final-Assembly Operations

After samples had been approved by the engineering department, they were divided into the various major sub-assembly units that could be assembled advantageously on the conveyor line and the final assembly units that had to be made on separate benches and fed to the conveyor line. The type of labor and the time required for these operations were then determined. Thus the personnel requirements for varying production schedules were easily obtained.

After determining the direct labor requirements, sufficient allowance for indirect labor was added to the various schedules. For instance, some of the large departments were allowed a sweeper, truckman, stock chaser, male supervisor, female supervisor, and foreman. The piece rate for the assembly was then determined by multiplying the base or piece-work day rate of the various classes of labor by the number of operators allowed and adding up the total. The entire group received this rate for each sub-assembly passed by the inspector at the end of the bench. This piece rate was then pro-rated at the end of the pay period according to the individual hours worked and the base rate for the type of work performed.

Procedure in Departments Manufacturing a Complete Unit

In our shop, we have one rather large department in which a complete article is produced. Punch press, screw machine, electroplating, assembling, and packing operations are performed in this department. The personnel and rates were obtained in the same way as for the sub- and final-assembly parts. However, indirect labor was included in the piece-work rate. Here we included not only foremen, but also die-setters, die repairmen, machine repairmen, screw machine set-up men, elevator operator, stock-room and tool-crib attendants, maintenance man, electrician, and pipe fitter. As a matter of interest, it may be mentioned that this department had, at peak production, 178 day and 64 night employes. The pay was based on the number of packed units delivered to the shipping room each pay period.

Applying the System in Departments where Many Individual Pieces are Produced

Our punch press department was engaged in the production of approximately ninety different parts this season. The rates were obtained in much the same manner as for assembling operations—that is, by multiplying direct hours of labor by the base rate and adding a sufficient number of hours to include all indirect labor. This department handled its own steel and scrap, and washed the parts and delivered them to the inspection department, where they were counted and paid for on the basis of good pieces passed. Night and day crews were run in this department. The scrap loss was very low, and the two crews carried on the work smoothly.

In summarizing the principal advantages of the group piece-work system, the following factors are outstanding:

1. Intermediate inspection is eliminated, because the operators know that they will be paid only for good units, and that the cost for repair work will come out of the total earnings of the group.
2. Counters and counting stations are not required. The chance for an incorrect count is eliminated, because the delivery slips for the assemblies and finished parts to stores are checked against the pay-count slips. The pay-count slips are made out by the inspector who passes the parts. Delivery slips are checked at stores.
3. Factory time-keeping is reduced to a minimum, one time-keeper keeping the time for 750 employes.
4. The labor required in making up the payroll is greatly reduced, as all employes on each type of work, and in each of the several groups, receive the

same rate per hour over the entire pay period. Thus the payroll make-up is no more complicated than it would be for straight day pay.

5. Only good workers will remain in each group, as the leaders will soon discover any incompetent workman and ask that he be removed.

6. The individual operators know at all times just what wages they are receiving, because they are given a schedule of rates which shows their daily earnings at various production rates when all members of the group are at work. No group is allowed to operate with too many workmen. However, the operators know that if one of their number is out and they are still able to keep up the production rate by working a little harder, all the amount saved goes into their earnings to increase their hourly rate. Thus the production rate is kept at a much more even rate than when the work is handled on the individual piece-work or bonus system.

7. Indirect factory labor is reduced to almost a negligible item and is easily controlled by a budget system.

The fact that everyone in our organization, from the factory manager to the elevator operator, is enthusiastic about the system testifies to the success with which it has been applied in our plant. The workmen like the system because they know that they reap all the benefits of increased effort and that the system operates fairly for both employer and employe. The foremen like the system because they share financially in the efficiency of their departments. It is a great advantage to the management, because the labor costs for both direct and indirect labor do not vary.

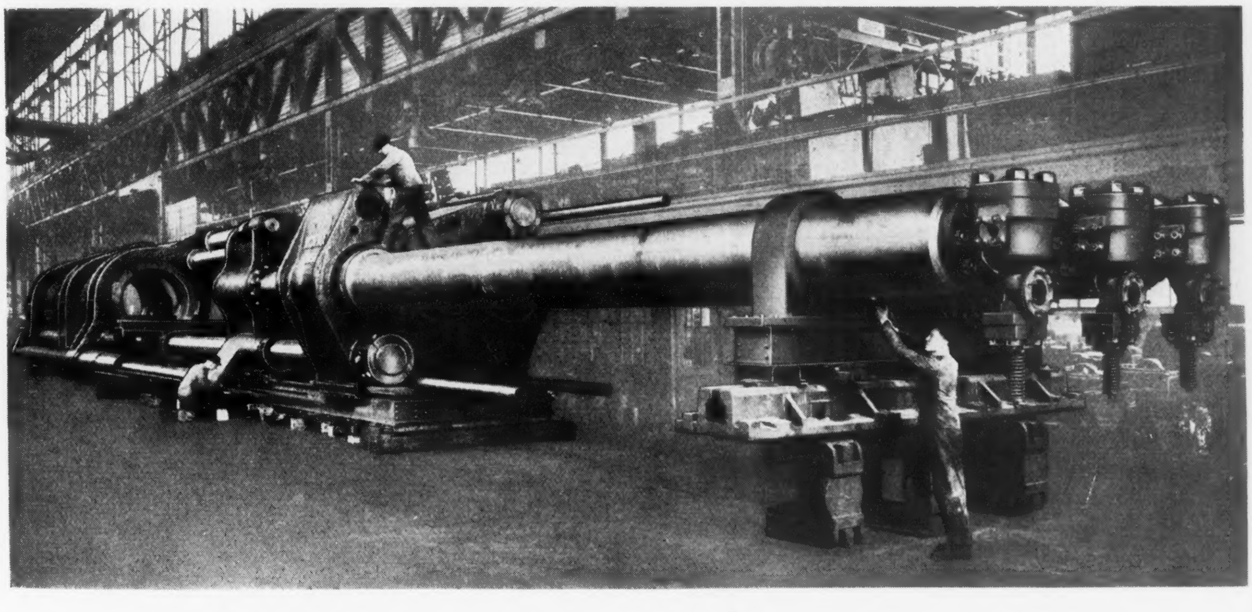
Drawing Shells Nearly Five Feet in Diameter and Twenty Eight Feet Long

By S. WEIL, Frankfurt a. M., Germany

Seamless steel shells and pipe up to 4 feet 9 inches in diameter and 28 feet long are drawn in a huge three-cylinder hydraulic press weighing about 560 tons. This press was built by the firm Hydraulic G.m.b.H., Duisburg, Germany. It is 130 feet long and exerts a drawing pressure of 1500 tons. An unusually long stroke—33 feet—permits a shell to be drawn successively through several dies, so that the shell can be completed in one heat. This is an advantage, as heating the shell between each draw impairs its physical properties.

Three different operating pressures are available on this press. Water is admitted to the central cylinder to obtain a pressure of 500 tons. When a 1000-ton pressure is required, water is admitted to the two outer cylinders only. The maximum pressure of 1500 tons is obtained by admitting water to all three cylinders.

Loading of the steel ingot over the dies is accomplished by hydraulic means. In stripping the mandrel or punch from the shell, more power is required than for the actual drawing. The necessary power is obtained by means of intensifiers. All controlling apparatus is so located that the operator has a good view of the entire press. In conjunction with this press, a vertical hydraulic press is used to pierce the ingot from which the shell is to be drawn. It requires 1800 horsepower to operate these presses.



Hydraulic Press which Has a 33-foot Stroke and is Capable of Exerting a Pressure of 1500 Tons

New Equipment Helps Shops to Survive

It is not Only When Production Runs High that Up-to-Date Equipment is an Asset; When Business is Quiet and Prices Close, It May Spell the Difference Between Success and Failure

By ARTHUR MUMPER

EVERY manufacturer knows that success depends on meeting his competitors' prices. And this is more necessary at the present time than ever. Yet the management of many plants does not seem to fully appreciate the important part that efficient equipment plays in successful competition.

One frequently hears manufacturers talk about wages as if wages were the determining factor in arriving at low costs. On the whole, wages in any given district are a comparatively unimportant factor in meeting competition, because practically all the plants pay the same wages. The important factor is equipment, because all plants are not equally well equipped. To be able to meet a competitor's price, one must have equipment as good as he has, or better.

In the city where the writer lives there are any number of shops trying to keep their heads above water, who are continuing to use equipment that should have been on the scrap-heap a number of years ago. This is not true only of small struggling shops. There are, for example, two plants with a total investment in buildings and equipment of approximately $1,500,000. Both are in the metal-stamping business.

When you step into the tool-room of one of the shops, you are transported back ten or twenty years. The press equipment is fair enough, but the management complains that it is impossible to build dies cheaply enough to get a fair share of the work offered. The dies built have to be figured at a loss in order to get the stamping contracts.

In the other plant, the management thinks that the trouble lies with the men. It is believed that they are not turning out enough work and that they are not cooperating. As a matter of fact, the toolmakers in that shop are just as good as any in the city, and they do as good work; but they have to get along with poor equipment.

For example, a very accurate and rapid method is used for locating holes for perforating dies. Later, the holes are enlarged in a drilling machine. That is all right if the drilling machine is good; but, in this case, the drilling machines are all old. The spindle bearings are worn and the spindles wabble; the tables are not square with the spindles, making it impossible to drill a hole square through a piece. Hence, when the die bushings and punches are inserted, it is necessary to spend many hours—sometimes days—in obtaining the required accuracy in the die.

On work requiring filing, men will spend an entire day doing by hand what could be done in two hours or less on a low-priced filing machine. After they are all through hand-filing, the work is likely to be less accurate than if it had been done by a machine. The shapers are fair, but have none of the modern attachments that save time. The hydraulic shaper is unknown in this shop. If one knows the little tricks that must be performed with the lathes, one can do a fairly good job by taking plenty of time. The milling machines are in rather poor condition, and there are not over six end-mills with all their cutting edges in good shape. Most of the cutters and drills are of the cheapest brands obtainable.

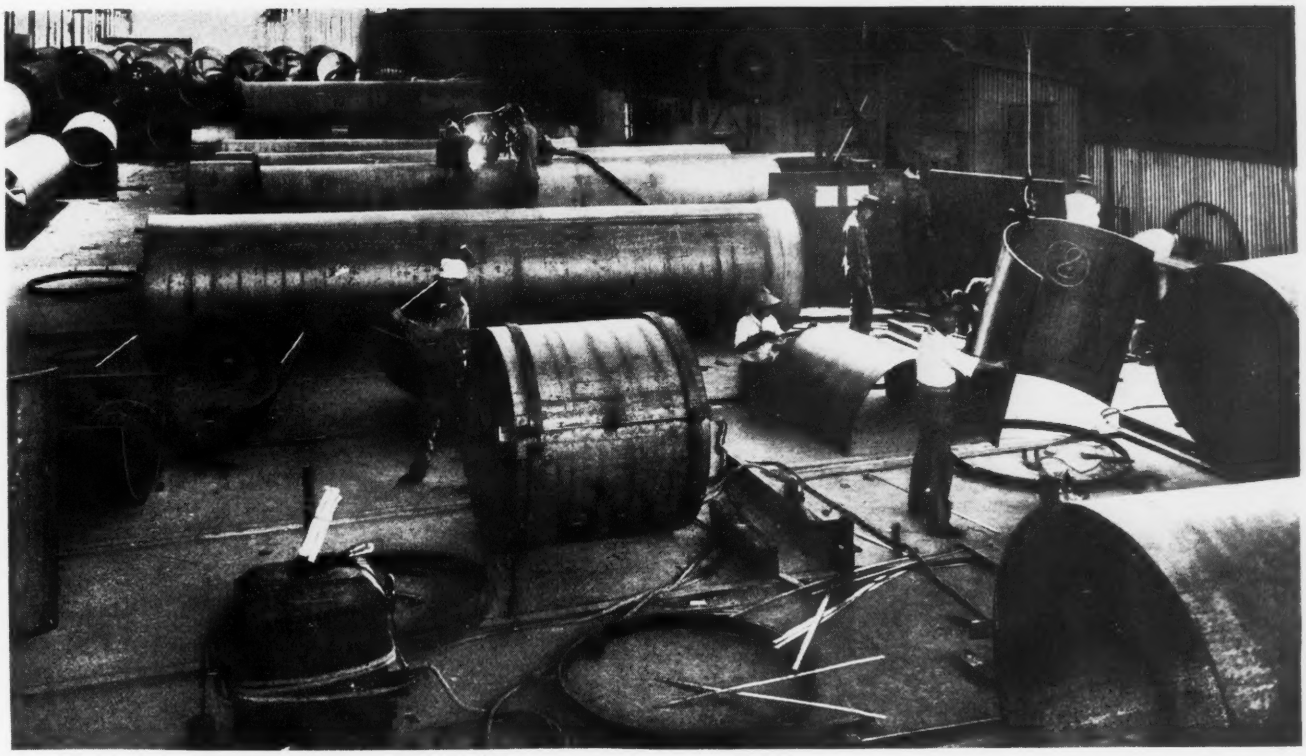
Cylindrical grinding is done in lathes. The dust and grit gets into the ways and bearings. Flat grinding is done on an old planer which has been rebuilt into a surface grinder. This machine requires from two to four hours to do what any of the well-known makes of vertical-spindle surface grinders would do in fifteen minutes or a half an hour. For example, one surface-grinding job took fifty-three hours, which could have been done in thirteen hours on a new vertical grinder. Forty hours of labor was wasted. How long would it take to pay for a new grinder if this time were saved?

Yet the management does not understand why highly skilled men cannot turn out work fast enough to meet competition. This shop finds that it can get dies built on the outside cheaper than in its own shop. The reason is—equipment.

The outside shop that builds the dies cheaper has machines adapted for all operations where time can be saved. Grinders of various types are available; jig borers locate and bore holes accurately. In other words, up-to-date machines aid the management in quoting lower prices; yet the shop makes a profit.

Many shops are poorly equipped, because in years past they have never charged depreciation in the right way. It has been a paper item to be found only on the books. A cash reserve to back up the figures is missing. However, one should hardly find fault with the accounting system in a plant where a lathe is kept in operation on die work with the front spindle 0.020 inch loose in the bearings.

In the preceding paragraphs the writer has merely attempted to indicate what is obvious to any man familiar with shop practice—that even at the present time, with so little work to be done in the shops, money is wasted by the use of old-fashioned equipment. Would new equipment throw men out of work? Hardly. If the new equipment made it possible to quote attractive prices, it is also likely that there would be more work to be done, rather than less.



Arc-Welding Large Steel Pipe in Japan

By MAURICE TAYLOR, Welding Technician
Lincoln Electric Co., Cleveland, Ohio

FEW mechanical processes have found such rapid and widespread application as arc-welding. Examples of the use of this process may be found in plants throughout the world. The practice here described is that followed by the Kawasaki Dockyard Co., Kobe, Japan, in welding steel pipe sections to form the 2100-millimeter (about 7 feet) main for Tokyo's water supply. A view of the pipe welding department is shown in the heading illustration. The "Electronic Tornado" welding process is used. Both the process and the equipment have been developed by the Lincoln Electric Company.

The sections used in making large pipe are delivered to the welding department in the form of half-cylinders, the smaller pipe being made from full cylinders. One of the advantages of the arc-welding process is that the abutting edges of the joints need not be beveled.

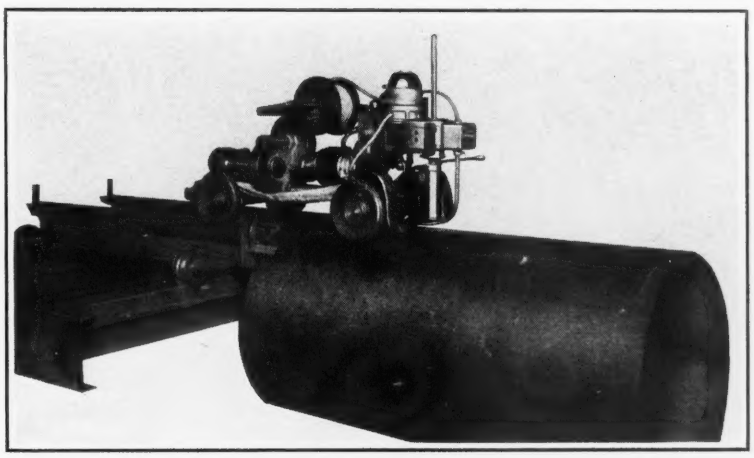


Fig. 1. A Small Power-Driven Tractor Carrying the Welding Head Rolls along the Top of the Pipe to Weld the Outside Seam

Hence, before forming, a large number of plates may be stacked together and planed at one time. The welding alloy is not deposited in the joint while welding. Instead, the alloy, in the form of a strip of rectangular cross-section, is inserted between the abutting edges and tack-welded in the joints.

Special clamping rings are used in assembling the sections, as indicated in the foreground in the heading illustration. These rings serve to hold the sections in a true cylindrical shape while the alloy strips are being tack-welded in place. After being tacked, the pipe is ready for the final welding.

A Small Tractor Feeds the Electrode along the Joint

To weld the joint, the pipe is located in position against a floating platform, as shown in Fig. 1. The welding head is mounted on a small power-driven tractor, which feeds the electrode along the joint at the rate of 70 feet per minute. With this arrangement, pipe of practically any diameter can be welded.

In welding the inside of the joint, the pipe is rotated 180 degrees and the tractor operated along the bottom of the pipe, as indicated in Fig. 2. When there are two opposite seams, the welding can be done more rapidly by using two tractors and performing the operations shown in Figs. 1 and 2 simultaneously. On plate up to 3/4 inch thick, only one pass of the tractor is required on each side of the joint. Fig. 3 illustrates diagrammatically the successive steps in completing a weld.

Concentrating and Shielding the Arc Gives a Highly Efficient Joint

Inferior welds are usually characterized by an excess of oxides and nitrides in the weld metal. Their presence not only lowers the tensile strength, but also embrittles the weld metal and decreases the resistance to corrosion. Obviously these elements are absorbed by the molten metal during the welding operation. This difficulty is overcome with the welding equipment described.

The head is equipped with a fibrous autogenizer which is fed into the carbon arc automatically. As this autogenizer burns, an inert gas is formed around the arc and prevents the molten metal from absorbing harmful gases from the surrounding atmosphere. By excluding these gases, tensile strengths up to 80,000 pounds per square inch are obtained, and a 30 per cent elongation in 2 inches is not rare.

Another advantage of this process is its speed of operation, which is not limited to the size of a metal electrode. A strong magnetic field is superimposed about the arc. This field controls the carbon arc, concentrating the heat so that rapid fusion of the welding metal results.

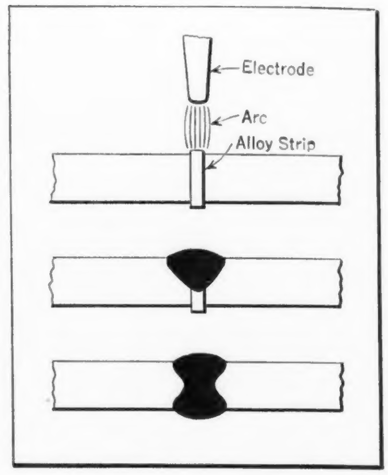


Fig. 3. Diagram Showing the Steps Required in Welding the Seams on Large Pipe

Fig. 2. The Same Tractor Shown in Fig. 1 Serves to Weld the Seam along the Inside of the Pipe

* * *

Mechanical Engineers Nominate Officers

The Nominating Committee of the American Society of Mechanical Engineers has selected the following nominees for 1933: President, A. A. Potter, Dean, Schools of Engineering, Purdue University, Lafayette, Ind.; vice-presidents, Harold V. Coes, management engineer, Ford, Bacon & Davis, Inc., New York City; James D. Cunningham, president, Republic Flow Meters Co., Chicago, Ill., and C. F. Hirshfeld, chief of research department, Detroit Edison Co., Detroit, Mich.; managers, Robert L. Sackett, Dean of Engineering, Pennsylvania State College, State College, Pa., Alexander D. Bailey, superintendent, Generating Stations, Commonwealth Edison Co., Chicago, Ill., and John A. Hunter, professor of mechanical engineering, University of Colorado, Boulder, Colo.

* * *

It is characteristic of the American people to live in the present and pay little regard to history. I believe this accounts in large part for our optimistic follies of 1929 and for the equally unwarranted depths of pessimism to which many of our so-called leaders, as well as the rank and file, have sunk today. If we had taken history into account in 1929, we would have acted much more wisely; and if we would learn our belated lesson in history even now, we would be wiser and happier.—*J. S. Tritle*, Vice-president and General Manager, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Economical Milling Procedure Developed by Engineering Study

By Careful Planning, a Marked Increase in Production Has Been Obtained in Milling Cylinder Blocks for Lycoming V-Type Automobile Engines—Second Article

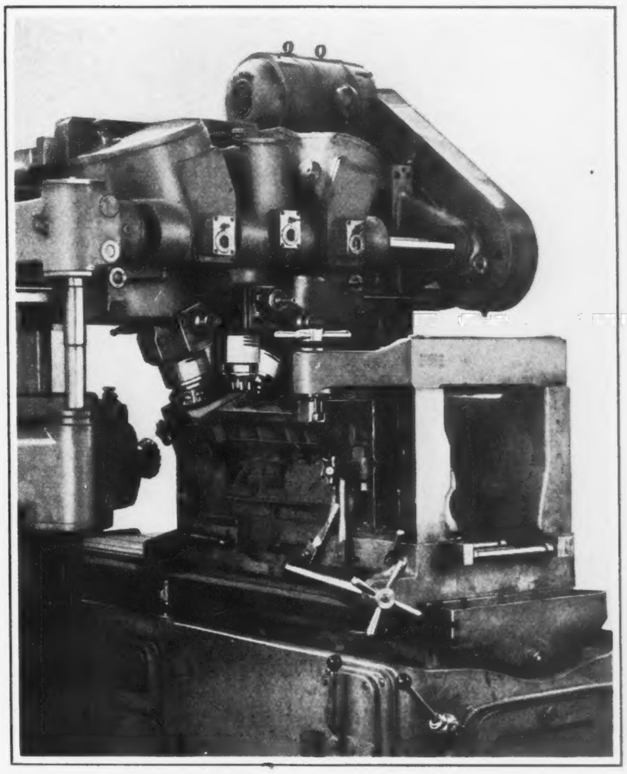
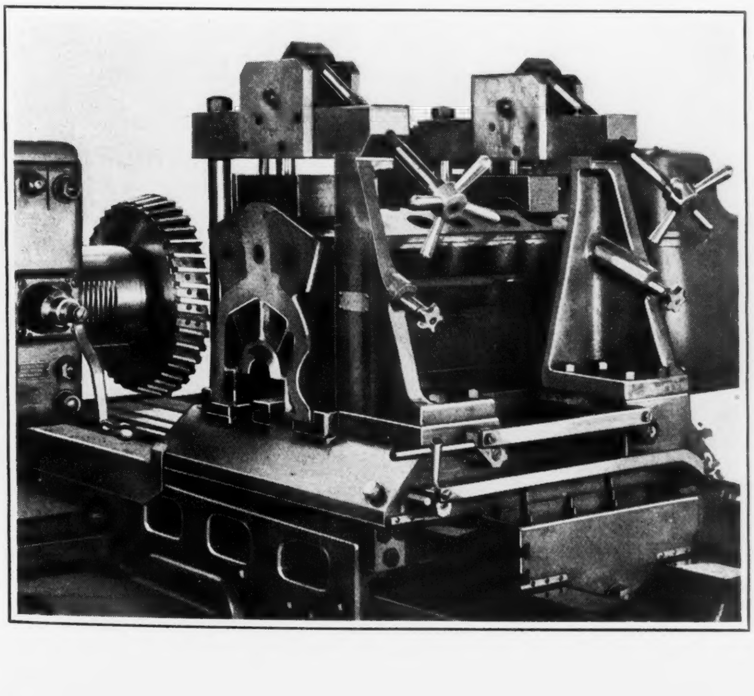


Fig. 1. Finish-milling Cylinder Head Contact Surfaces and Pads for Oil Seal, Oil Relief, and Fuel Pump on a Duplex Hydromatic

THE first three milling operations performed on V-type cylinder blocks at the plant of the Lycoming Mfg. Co., Williamsport, Pa., were described in July MACHINERY, page 827. The present article describes the finish-milling operations on the cylinder blocks. The milling machines and special fixtures employed, as in the case of the previous operations, were built by the Cincinnati Milling Machine Co. Many features of these machines are protected by U. S. and foreign patents.

The fourth milling operation on the V-type cylinder block consists of finish-milling the contact faces for the cylinder head, and milling the oil-seal pad on top of the block and the fuel pump and oil relief pads on the side of the block. This work is performed on the machine shown in Fig. 1 and might be called a companion operation to the third operation described in the preceding article in that it finishes the surfaces rough-milled in that operation and completes, in one cut, the machining of the pads on the top and side, not previously milled.

Fig. 2. Duplex Hydromatic with Wide Table Rigidly Supported at Sides for Milling Ends of Cylinder Block



The conveyor type fixture illustrated is similar in design to the one used for the third operation. It has disappearing-type dowel-pins and hardened blocks for locating the work. The conveyor rolls are elevated by one lever. An approximate end-stop and side guides are provided.

The cylinder block is secured by clamps that enter the cored holes in the ends. These clamps are operated by pilot wheels. There are two quick-positioning side stops at each end and on the right side of the block. Opposite the stops are two hand-clamps. These stops and clamps are located at points well up on the work so that they absorb any side thrust exerted by the cutters.

A guide at the top of the fixture is supported by the upright at the right-hand side of the machine. All the spindle carriers on this equipment, with the exception of the housings for the angular positioning of the spindle, are composed of standard parts. These special units, together with the standard units of the machine, are all automatically lubricated.

Tungsten-carbide face-milling cutters are used throughout, in order to obtain high production with a high degree of accuracy (flatness) and finish. The first four operations described complete the

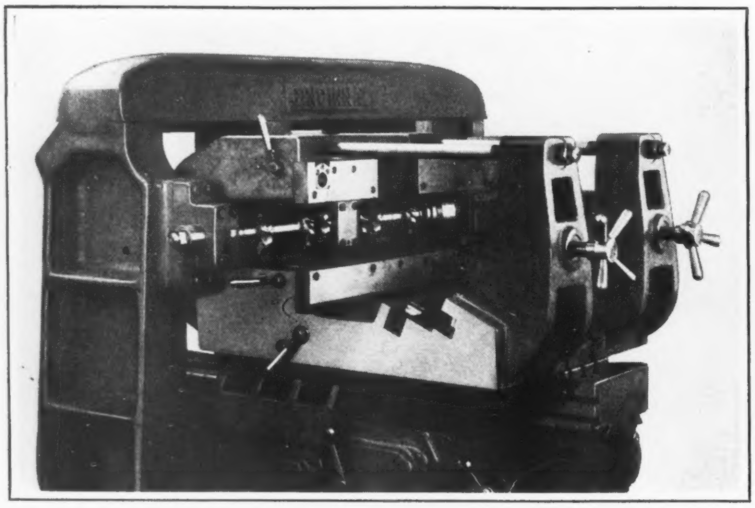


Fig. 3. Equipment Employed for Straddle-milling Ends of Main Bearings of Cylinder Block

finishing of the top, bottom, and side surfaces of the cylinder block. It will be noted that one roughing and one finishing cut serve to finish all important surfaces.

Milling Ends of Cylinder Block

The fifth operation, that of milling the ends of the cylinder block, is performed on a standard Cincinnati Hydromatic machine, equipped as shown in Fig. 2. The fixture is so placed that the work can be rolled into position from one side of the table and located against a disappearing end-stop. After the cut has been taken, the work is rolled off the opposite end of the table. The cylinder blocks are transported by roller conveyors.

Hardened locating blocks, removable disappearing dowel-pins, and conveyor rollers are built into the fixture. The height of the conveyor rollers can be varied by a lever to elevate the work or lower it on the locating blocks. As the work is quite long, guide brackets are bolted to the outer edges of the machine bed to support the overhanging ends at each side. These guides provide an effective table supporting surface as wide as the work is long. Stellite face mills of large diameter are used for this operation. Long cutter life is obtained, as the desired production is secured by using a moderate rate of feed.

Final Milling Operation on Cylinder Block

The plain Cincinnati Hydromatic shown in Fig. 3 is used for straddle-milling the main bearings of the cylinder block. For this final operation, the work is located on its side and is fed directly toward the straddle-milling cutters on the arbor. This fixture is also provided with rollers for conveying the work into and out of the machining position. The finished oil-pan face and two disappearing dowel-pins serve to locate the work for this operation.

A center arbor support and the outer brace from the bed to the over-arm which carries the outer arbor support make a very rigid structure. The outer guide surfaces are built up from the bed to eliminate any overhang of the fixtures. The outer supports have an adjustable hardened steel rail on which the fixture slides. This fixture completes the special equipment employed for the major milling operations on the cylinder block. The milling of the cylinder head will be described in the next article.

* * *

New Cast Iron Specifications

As a result of several years of research work by the Gray Iron Institute, Cleveland, Ohio, the specifications for gray-iron castings have been revised. In the new classifications, gray iron is divided into seven tensile-strength groups—20,000; 25,000; 30,000; 35,000; 40,000; 50,000; and 60,000 pounds per square inch.

The number of tensile and transverse test bars for standard tests has also been increased from one to three, being 0.875, 1.2, and 2 inches in diameter, respectively. This has been done in order to provide adequate design information pertaining to various sections in castings. Heretofore, the single arbitration test bar has not given results that could be applied satisfactorily to the whole range of section sizes. It will now be possible for foundrymen to state specifically the strength that can be expected in critical sections of their castings.

A plan is also being worked out whereby any foundry submitting castings to tests and metallurgical inspection will be able to certify that its product fulfills the requirements for one of the classes or groups of gray iron considered in the specifications.

* * *

Engineers' Club Aids in Placing Unemployed Engineers

The Engineers' Club, 1317 Spruce St., Philadelphia, Pa., whose Technical Service Committee was referred to on page 829 of July MACHINERY, announces that the committee has in its files the names and records of 800 men in all branches of engineering, at present unemployed and immediately available, not only for normal engineering positions, but for investigation work where engineering knowledge and thoroughness may be of special importance. Recently, for example, the committee received the following message over the telephone: "I need a man tomorrow morning who is experienced in gold mining, to make a dependable survey. On his decision will depend investment or no investment." The right man was on the job twenty-four hours later.

Chart for Use in Designing Helical Springs

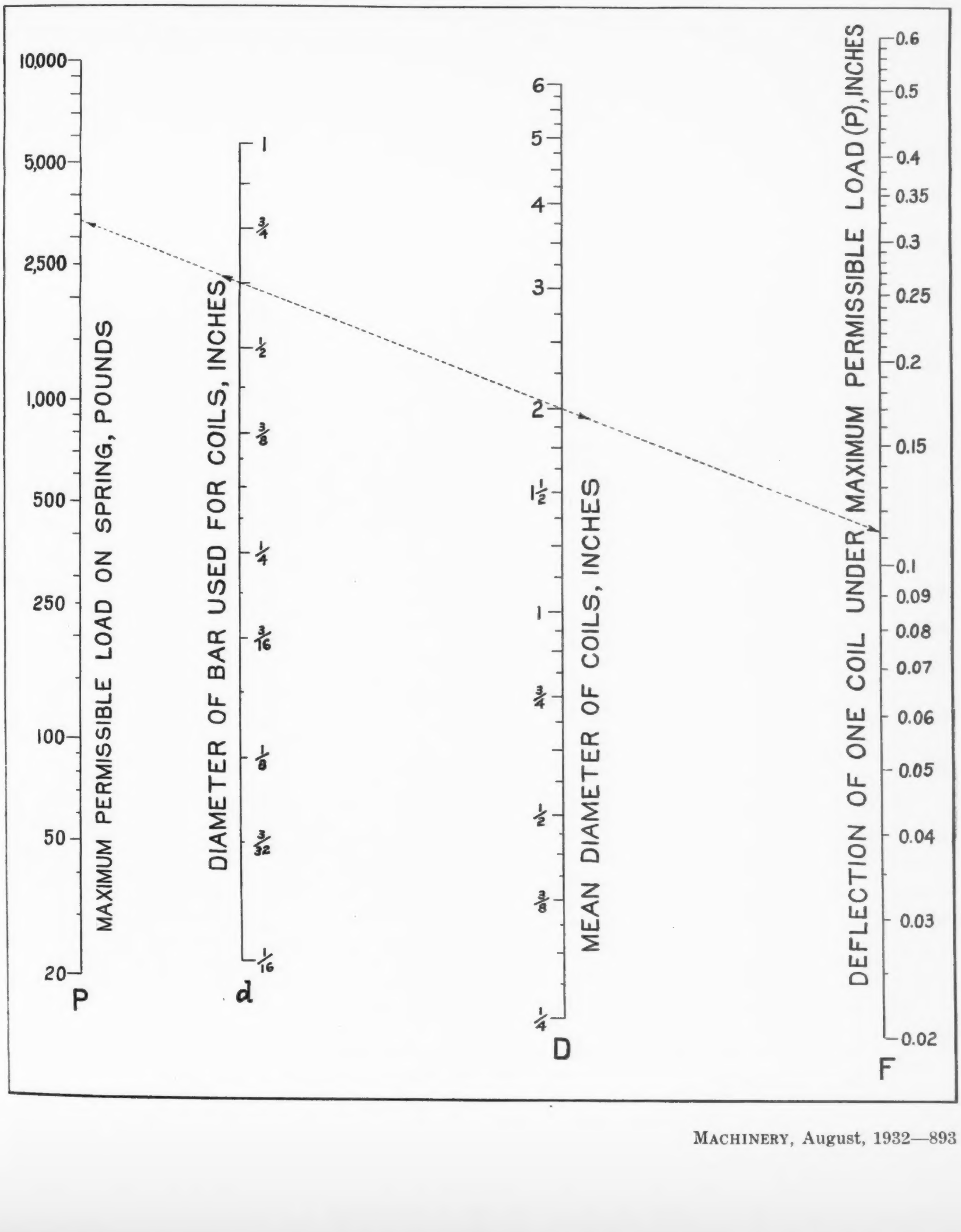
By A. HUTTON

This chart for designing helical springs made from round bar stock is based on a maximum shear stress of 70,000 pounds per square inch. The following examples show how the chart is used.

Example 1—Spring made from bar stock 5/8 inch in diameter; mean diameter, 2 inches; maximum shear stress, 70,000 pounds per square inch. Find permissible load and deflection per coil.

Place a straightedge on points 5/8 and 2 of scales *d* and *D*, respectively, on the chart. Then scale *P* shows the permissible load to be 3350 pounds; and scale *F* gives the deflection per coil as 0.112 inch.

If the permissible shear stress is 80,000 pounds per square inch, the deflection per coil $= 0.112 \times \frac{80,000}{70,000} = 0.128$ inch, and the permissible load would be 3830 pounds.



Example 2—A spring is to have twenty active coils; total deflection, 2.8 inches; load, 4200 pounds; maximum shear stress, 87,500 pounds per square inch.

Find the diameter of the bar stock required and the mean diameter of the coils. First, find the permissible load for a maximum stress of 70,000 pounds per square inch. This equals $4200 \times \frac{70,000}{87,500} = 3360$ pounds. Deflection per coil for maximum stress of 70,000 pounds per square inch =

$$\frac{2.80}{20} \times \frac{70,000}{87,500} = 0.112 \text{ inch}$$

Now, place a straightedge on the scales P and F so that it passes through the points corresponding to 3360 pounds and 0.112 inch. Then, read off the size of the bar required—5/8 inch—and the mean diameter of the coil—2 inches—on scales d and D, respectively.

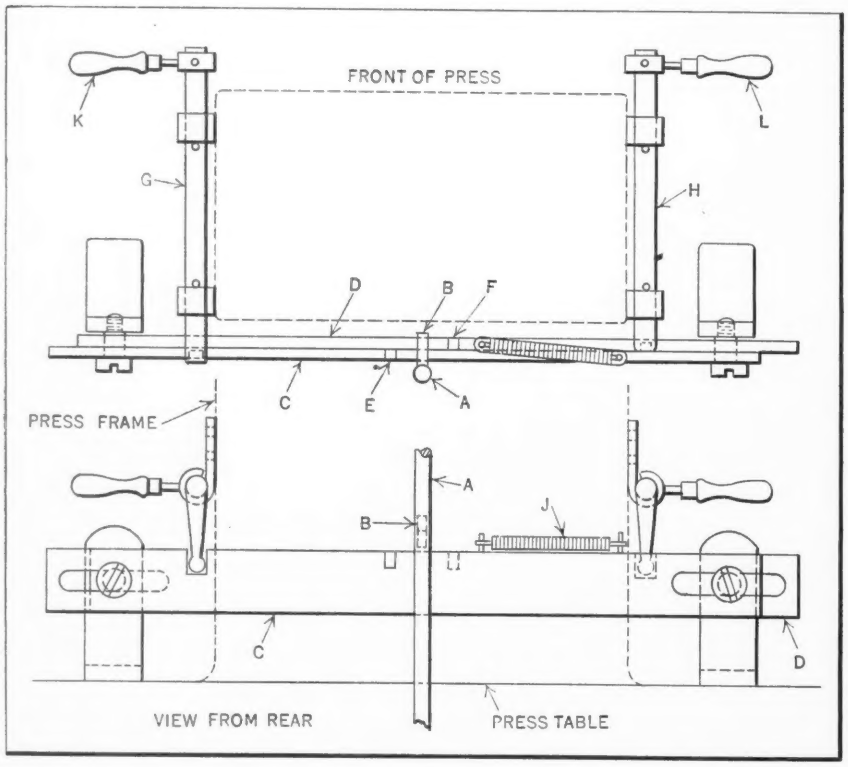
* * *

At the annual convention of the American Wood Preservers' Association, the permanence of creosoted piles was referred to by one of the speakers. Creosoted piles driven in 1911 were recently examined, and they had the appearance of having just been driven. Both the inside and the outer portions of the wood were perfectly sound. The creosote treatment penetrated to a depth of 2 1/2 inches. The piles had been driven into a sandy clay alternately wet and dry.

Two-Hand Safety Device for Small Presses

By CHARLES H. WILLEY

There is probably no more dangerous task for one's hands than that of operating a fast power punch press that has no guards or safety devices. Of course, some kind of guard should be used on every press of this type. The accompanying diagram shows the arrangement of a two-hand guard designed by the writer for presses such as that referred to. This safety arrangement could also be applied to larger presses.



Arrangement of Two-hand Safety Device Used on Small Punch Presses

The trip-rod A, which actuates the finger that engages the clutch and causes the press ram to come down, is operated by a floor pedal. On rod A is welded a projecting lip B having a rectangular section. Two cross-bars C and D, with properly spaced slots E and F, are mounted on vertical brackets at the back of the press, as shown. These cross-bars are actuated horizontally by the rods G and H at each side of the press, which are fitted with operating handles K and L. A coil spring J, secured to pins in each of the cross-bars, keeps them in the "safe" or blocked position, so that the lip B on the trip-rod cannot be moved downward.

By grasping the handles K and L and pulling them downward, the bars C and D will be moved into such a position that the slots E and F will be directly under the lip B, so that the trip-rod A can be operated. As each hand must grasp a handle before the press can be tripped, there is no danger of the hands being injured by the press. Quite a number of these safety devices are in use in our plant, and we have not had an accident within the last two years on any press so equipped.

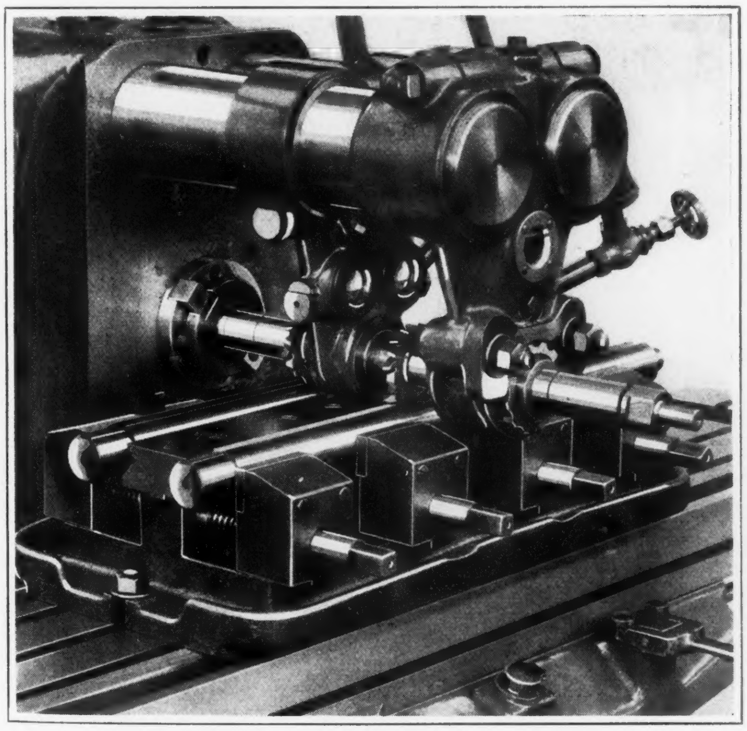
* * *

A general-purpose photo-electric relay with several new features has been developed by the General Electric Co., Schenectady, N. Y. Among the applications for which this relay may be used are the operation of counting devices—for example, the counting of boxes of materials, bags, vehicles, or persons; the control of mechanisms, such as the sorting of objects according to size, shape, or reflecting ability, the deflecting of packages on conveyors, the stopping of paper machines when the paper breaks, etc.; and the starting and stopping of machinery where mechanical switches are impractical.

Keyway Milling Production Increased Over 100 Per Cent

In the accompanying illustration is shown a set-up that provides an accurate and rapid means of milling keyways in armature shafts. The fixture holds two pieces and is so constructed that various sizes and styles of shafts can be accommodated. The length of the cut on the shaft shown is 14 inches. Heretofore, it has been necessary to use a feed as low as 3 inches per minute in order to obtain the finish desired for a keyway of this kind. The former cutting speed was 65 feet per minute and the floor-to-floor time required for milling two complete shafts was five minutes.

With the new Kearney & Trecker milling machine of the manufacturing type, equipped as illustrated, it has been possible to increase the feed to 7 inches per minute and the speed to 90 feet per minute. The floor-to-floor time for two shafts is now 2 1/3 minutes, which is equivalent to an increase in production of 114 per cent. The increased speed is made possible by the greater rigidity of the new machine. The life of the cutters between grinds has also been increased 30 per cent, although they are operated at a faster speed and feed.



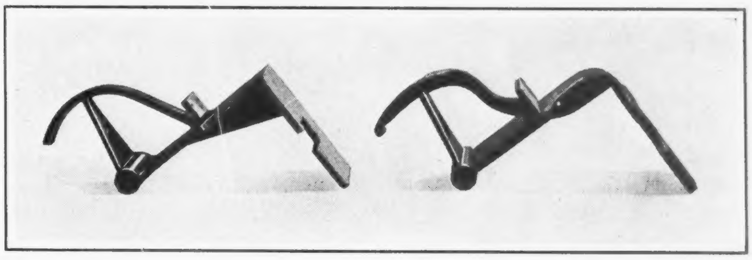
Keyways 1/2 by 1/4 Inch by 14 Inches are Milled in the Two Armature Shafts Shown in this Set-up in 2 1/3 Minutes, Floor-to-Floor Time

A feature of this set-up is the hinged arbor support, which is shown between the cutters. With this support, it is possible to remove the arbor without disturbing the setting of the cutters. This permits the cutters to be ground on the arbor and also allows arbors carrying a different set of cutters to be quickly substituted for other operations.

* * *

Arc-Welded Model Used in Making Pattern for Casting

The aluminum bracket for a motion picture projector, shown at the right in the accompanying illustration, was cast from a wood pattern, but the pattern was made in a most unusual manner



The Arc-welded Steel Bracket at the Left was Constructed as a Model for Making the Pattern for the Aluminum Casting Shown at the Right

through the ingenuity of a Cleveland mechanic. Instead of making drawings and blueprints, the design was worked out in arc-welded steel, as shown at the left of the illustration. Scrap steel was used in building up this model by the "cut and try" method, the pieces being joined by a Lincoln "Stable-Arc" welder.

The pieces were first welded together to give the approximate shape desired, and then checked in actual use with the projector. The design was refined by welding on additional metal where needed and cutting away other sections as desired, by means of the carbon arc.

When the steel model was completed and approved, it was turned over to the patternmaker, who used it in place of a blueprint in making the wood pattern, all dimensions being taken from the steel model. This unusual procedure made it unnecessary to make drawings and blueprints, and afforded an opportunity to try out the welded steel model under actual working conditions before constructing the wood pattern for making the mold used in casting the aluminum bracket.

* * *

The Westinghouse twin motors that will drive the new electric passenger locomotives on the Pennsylvania Railroad between New York and Washington are said to develop more horsepower per pound of weight than any other single-phase commutator motor.

Oscillating Shield for Ejecting Scrap from Trimming Die

By EDWARD LAY

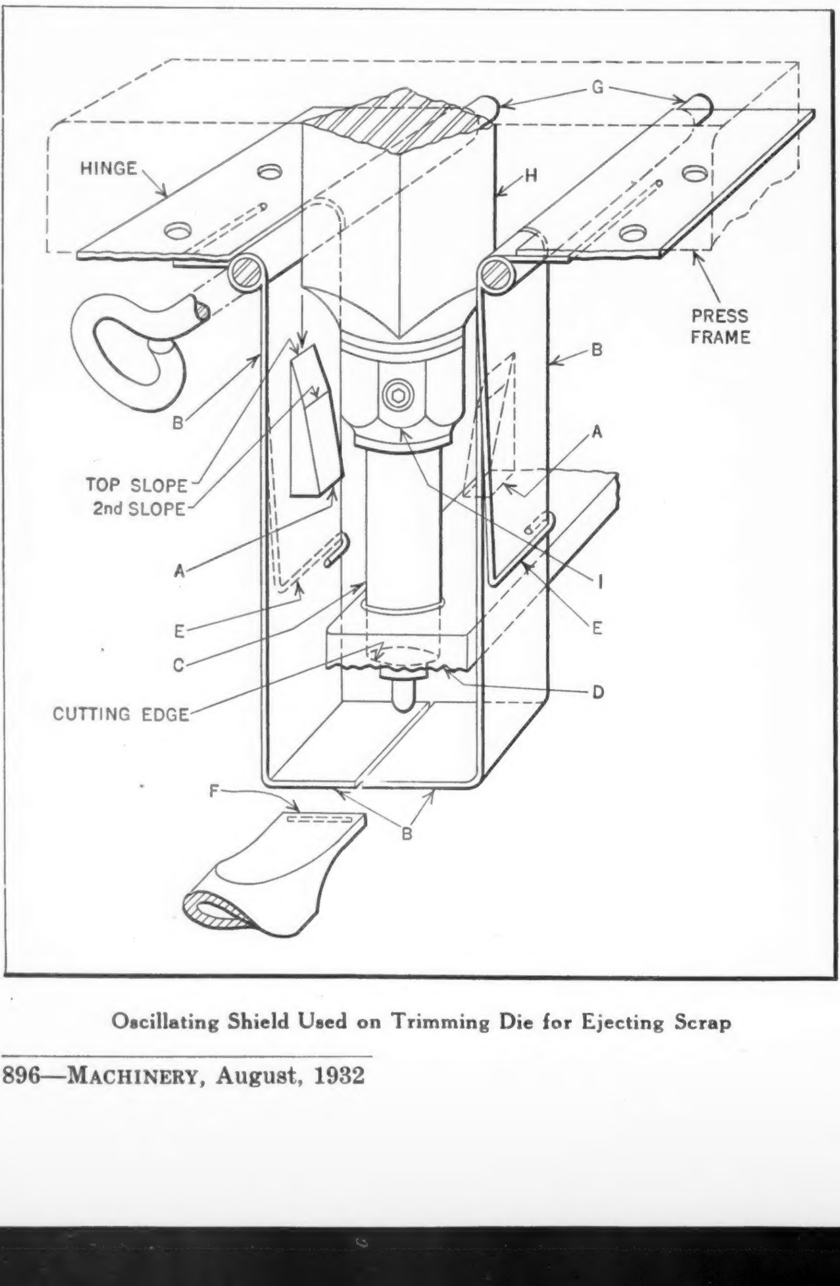
A simple yet effective device used on a ten-plunger Waterbury Farrel eyelet press for ejecting scrap is shown in the accompanying illustration. The device is employed on the eighth-stage plunger *H* which trims a ring or washer-shaped piece of scrap stock from the work. The trimmed scrap remains on plunger *C* on the up stroke, and is stripped from the punch by stripper *D*. A blast of air from the compressed air nozzle *F* then ejects the scrap from the die. Previous to the application of the device shown, the scrap pieces would sometimes catch in the die, even though a very heavy air blast was used. The oscillating scrap shield, applied as illustrated, eliminated this trouble and enabled the scrap to be ejected with a comparatively light blast of air.

The operation of the device is as follows: The two opposite corners of the descending plunger *H* come in contact with the top slope of the two wedges *A*, causing the two shields *B* to open up to the right and left. When the descending plunger corners reach the second slope of the wedges *A*, the opening is wide enough to permit the end of the punch to pass. Springs *E* hold the wedges in contact with the plunger corners.

After the trimming punch *C* passes through the opening and trims the shell, it ascends with the trimming around it. When it leaves the second slope of the wedges, the shields *B* start to close, and after it passes the top slope, the closing movement is completed. At this moment, the trimming around punch *C* makes contact with the stationary stripper *D* and the punch continues to ascend until the cutting edge is 1/16 inch above the lower grooved surface of stripper *D*. The trimming is then free and drops down on the shelf formed by the bent portions of shields *B*. A gentle but well directed compressed air stream from the nozzle *F* then blows the trimmed scrap backward into a chute leading to a container, thus completing the operating cycle.

When the trimming punch needs to be sharpened, the hinge pins *G* are withdrawn by means of the eyed ends, and the shields *B* are dropped, so that the chuck *I* which holds punch *C* can be unscrewed from plunger *H*.

With slight modifications in design, this device can be applied to dies of various kinds.



Oscillating Shield Used on Trimming Die for Ejecting Scrap

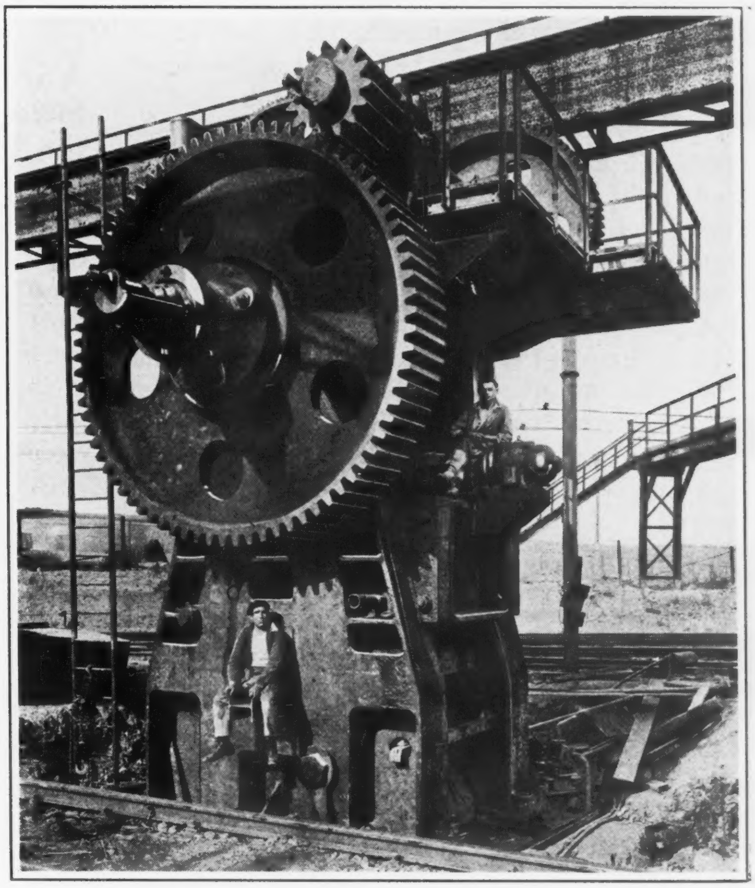
Owen D. Young on Unemployment

At the dedication of a new group of buildings for the Harvard School of Business, Owen D. Young, Chairman of the Board of the General Electric Co., ended his address with the following remarks: "Then, too, we must deal with this question of unemployment, which I regard as the greatest economic blot on our capitalistic system. There is no answer except that the managers of business have not yet learned how to make their system function so that men willing and able to work may do so. There is no limit to the consumption of the world. It is limited only in its individual compartments. We cannot eat more than so much bread or meat. We cannot wear more than so many clothes, and so we may have overproduction in individual lines. But there are innumerable wants yet unserved, and while culture grows, these wants will outrun our capacity to produce things to satisfy them. The world does not owe men a living, but business owes men an opportunity to earn a living."

Notes and Comment on Engineering Topics

In a recent paper by Arthur W. Carpenter, manager of the testing laboratories of the B. F. Goodrich Co., Akron, Ohio, before the American Society for Testing Materials, it was stated that one well-known American automobile uses in its construction 48 pounds of rubber products, exclusive of the tires, there being 65 uses for rubber on automobiles.

A dreamer named Morse claimed that he could send messages hundreds of miles by wire; practical men knew that it could not be done. Another dreamer whose name was Bell claimed that one would be able to hear the human voice across continents; practical men knew that was foolishness. Two dreamers by the name of Wright thought that men might fly; practical men laughed at the way in which they were wasting their time. Now, there are dreamers who believe that by the application of intelligence and good will industrial depressions may be prevented; but practical men know that there always must be severe ups and downs in production and consumption.



A German Scrap Shear of Enormous Proportions Built for Cutting up Girders 43 Inches Deep. The Shear was Built by Demag A. G., Duisburg. The Maximum Shear Pressure is 2000 Tons, the Machine being Driven by a 150-horsepower Motor at a Speed of from 4 to 8 Strokes per Minute. Total Weight, 200 Tons

The possibility of reducing the weight of railway cars is well illustrated in the design of a new car recently built at the Edward G. Budd Mfg. Co.'s plant, which introduces many radical departures in accepted practice. The new car weighs about 13,500 pounds and is intended to carry forty passengers. This makes an allowance of 340 pounds car weight per passenger, as compared with 1000 pounds in a regular railway coach, and 5000 pounds in a Pullman sleeper. The framework of the car is made from stainless steel, spot-welded. The wheels are fitted with demountable pneumatic tires carrying an 85-pound pressure. A tire life of 20,000 miles is expected. The brakes are of the automobile type.

The new George Washington Bridge over the Hudson River, which, while not entirely completed, was recently opened to traffic, is a suspension bridge having a main span of 3500 feet—more than twice as long as any of the famous suspension bridges of the past. The bridge is supported by four cables, each 36 inches in diameter and consisting of 26,474 wires. The diameter of each wire is 0.196 inch. The wire is of a special composition and heat-treated, with an ultimate strength of 220,000 pounds per square inch.

Mechanical refrigeration, as applied to refrigerating railway cars, has definitely passed the experimental stage and is ready for practical application on a large scale. The North American Car Corporation has announced that 500,000 car miles of successful transportation has been completed with its new "Frigicar." The power for the refrigeration is drawn from the car axle. Two-year tests have overcome the initial difficulties.

EDITORIAL COMMENT

Two Roads Are Open to Industry—Which is the Better?

There are two lines along which American industry can proceed. Each has its advantages and its disadvantages. It is not possible to realize all the advantages without making some sacrifices.

Industry can proceed as in the past with complete competitive freedom, each manufacturer conducting his own business according to his own judgment. When business is active and prosperous, this plan works well; but it has the drawback of producing periods of over-expansion and over-production, which are inevitably followed by a decline in business, financial difficulties, business failures, and unemployment.

Then there is the cooperative plan of controlled production, as proposed by Mr. Swope, president of the General Electric Co. This plan has not yet been tried, and it is therefore impossible to foresee all the conditions that might arise in its operation; it is claimed by its sponsors that it would make for more stabilized business conditions—would avoid, to a considerable extent, extreme peaks and valleys in business. This advantage, however, would have to be bought at the price of restricting individual enterprise and superimposing the consensus of opinion of an industry as a whole on the individual judgment of each manufacturer. Some will say that this is too great a price to pay. Others will say that we are now paying too high a price in maintaining uncontrolled competition.

The question is one that will have to be decided by American industry sooner or later. It is one having too great ramifications to permit of snap judgment. If a new departure is decided upon, there will have to be much experimenting and many changes in the proposed plans before they will work to satisfaction. It is much like the building of a machine for an entirely new product. The general idea of a machine may be clear in the designer's mind, but the methods of achieving the desired ends are arrived at only by painstaking study, experimentation, and willingness to try out new ideas whenever it is believed that a change is desirable.

A Step that Will Help Increase the Use of the New Tool Alloys

The announcement of a reduction in the price of carbide cutting-tool alloys recently made by leading makers of these materials will be welcomed throughout the mechanical industries. In many instances, executives have expressed the thought that the high price of the new cutting carbides was the main obstacle to their general and effective application in the machine shop industries. Sometimes, even though the material proved satisfactory from a mechanical point of view, it was not economical to use, as compared with the cutting tools formerly employed. The reduction in price should have a tendency to broaden the field of application of these cutting tools considerably; and when industry resumes more normal activity, as we all expect that it will in the not too far distant future, the applications for which these tools are advantageous will be still more numerous.

Two Ways of Selling Machinery, One of which is Successful

A manufacturer was in the market for a certain type of machine. He was called upon by a salesman whose main argument consisted in asserting that all competing machines were unsatisfactory and not worth buying. After having listened to this kind of sales talk for more than half an hour, the prospective customer said: "You have convinced me that I do not need your machine at all. You have told me that most of the machines of this type are unsatisfactory and that yours is just a little better than the others; but it does not have to be very good to be better than the machines that you have pictured." And with that he dismissed the salesman.

Contrast this sales method with that of an Ohio machinery salesman who has been most successful. Let us say that he is selling molding machines. He starts out by telling the prospective customer about the remarkable advance that has been made in molding machines by everyone in the industry, mentioning each make by name. He picks out the good features of his competitors' machines and elaborates upon them; and when he has finally convinced his customer that modern molding machines are so superior to the product of a decade ago that there is no doubt of the desirability of buying, he points out that, in all this advance, his own firm has kept just a little bit ahead of the procession, and describes the advanced features on his machines that are not yet available in other improved types. Whenever there is any chance to make a sale, he usually makes it.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Roller Lock for Change-Gears Instead of a Key

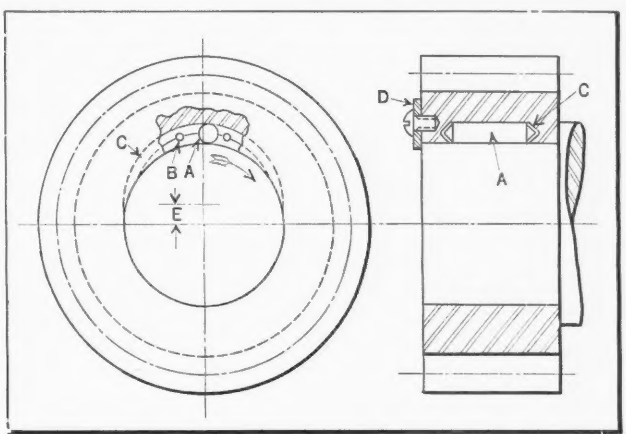
By WALTER WELLS

To facilitate changing gears on the shaft of a special machine, a roller type of lock built into each gear is employed in place of the key ordinarily used for this purpose. All that is required to change a gear is to push the gear on the shaft. When the machine starts, the roller automatically locks the gear tightly to the shaft. Obviously, this arrangement has many other advantages, including the elimination of slip washers and nuts for holding the gears axially on the shaft and the use of wrenches. The lock, as shown in the illustration, consists of the roller *A* confined between the two pins *B* in the recess *C*. It is based on the roller-clutch principle.

With the shaft rotating in the direction of the arrow, the roll is moved toward the right until it is clamped tight enough between the bottom of the recess and the shaft to cause the gear and shaft to rotate together. There will be no slipping of the roll, because an increased torque on the shaft will result only in a greater clamping action.

The shaft was filed to a 0.001 inch back taper, and the hole in the gear was given an opposite taper of 0.001 inch to prevent the gear from "walking" off the shaft. A small disk *D* was screwed to each gear to prevent the gears from being assembled on the shaft backward. This disk also marked the position of the roller *A* which, in order to be assembled easily, must be at the bottom of the recess.

The manner in which the recess was machined also deserves mention. After boring the shaft hole, the gear was located off center on the lathe faceplate an amount *E* equal to the diameter of the roller. Incidentally, the diameter of the roller was made equal to about one-sixth of the bore diameter. A special tool was then used for boring the recess to produce the vee ends. After boring, the roller, which was made of drill rod, was filed to allow 0.002 to 0.003 inch play between the shaft and the deepest part of the recess. The ends of the roller were then pointed, and finally hardened and drawn to a blue color.



Method of Locking a Gear to its Shaft by Means of a Hardened Roller

Compound Planetary Speed Reducer

By EDWARD HELLER

A compound planetary speed reducer, designed to give an enormous amount of reduction in a unit of very small size, is shown in the illustration (see next page). The gearing consists of a stationary gear *F*, doweled to housing *D;* a low-speed gear *R*, fastened to the low-speed shaft *E;* planetary pinions *G* and *H;* planetary gears *L* and *M;* and a high-speed pinion *P*, fastened to high-speed shaft *Q*.

Pinions *G* and gears *M* are carried on shafts *J*, while gears *L* and pinions *H* are carried on the sleeves *K*, the two assemblies being held on the planetary arm *N*. Pinions *G* and *H*, and gears *F* and *R*, have the same number of teeth; but gears *L* and *M*, although they are of the same pitch diameter, do not have the same number of teeth. In this case, *L* is a normal gear, while *M* has one tooth more than *L*, but is cut on the same pitch diameter.

The fact that gears *M* and *L* are both driven by the single pinion *P* makes possible the large speed ratio between the driver and driven shaft. It may be well to point out here that the ratio will be greatly decreased if pinion *P* is made with two sets of teeth in which one set is larger by a tooth than the other, and the gears *L* and *M* are made normal—that is, *M* is made to correspond with the lower half of the divided pinion *P*.

The method of calculating the ratio of this kind of reducer is not very different from any other, although the fact that the movement goes through two sets of gears may make it confusing. An example will make the method clear.

Referring to the illustration, the number of teeth in the different gears of the mechanism are as follows: $F = 50$, $G = 20$, $H = 20$, $R = 50$, $L = 80$, $M = 81$, and $P = 32$.

First, assume that all the gears are locked tight and that the entire mechanism, case and all, is given one revolution. Thus, both shafts E and Q are given one revolution. Next, assume that arm N is held stationary, and that the case D is turned back one revolution. As this one revolution is made, we analyze the rotation of the various gears, noting first what happens to shaft Q and then to shaft E. The movement is added to or subtracted from the first revolution in each case, and the two results are set up as the ratio.

Equations can now be written from this information. Assuming that the first revolution was made in a clockwise direction, the second revolution is made in a counter-clockwise direction. It will be noted that when we turn the case back one revolution, while holding the arm still, the shafts revolve in a counter-clockwise direction; so we must subtract the calculated movement from the first revolution of both the driving and the driven shafts. Thus we have,

Movement of driver Q equals

$$1 - \frac{\overset{F}{50} \times \overset{M}{81}}{\underset{G}{20} \times \underset{P}{32}} = 1 - \frac{405}{64} = \frac{64 - 405}{64} = -\frac{341}{64}$$

and movement of driven shaft E equals

$$1 - \frac{\overset{F}{50} \times \overset{M}{81} \times \overset{P}{32} \times \overset{H}{20}}{\underset{G}{20} \times \underset{P}{32} \times \underset{L}{80} \times \underset{R}{50}}$$

$$= 1 - \frac{81}{80}$$

$$= \frac{80 - 81}{80} = -\frac{1}{80}$$

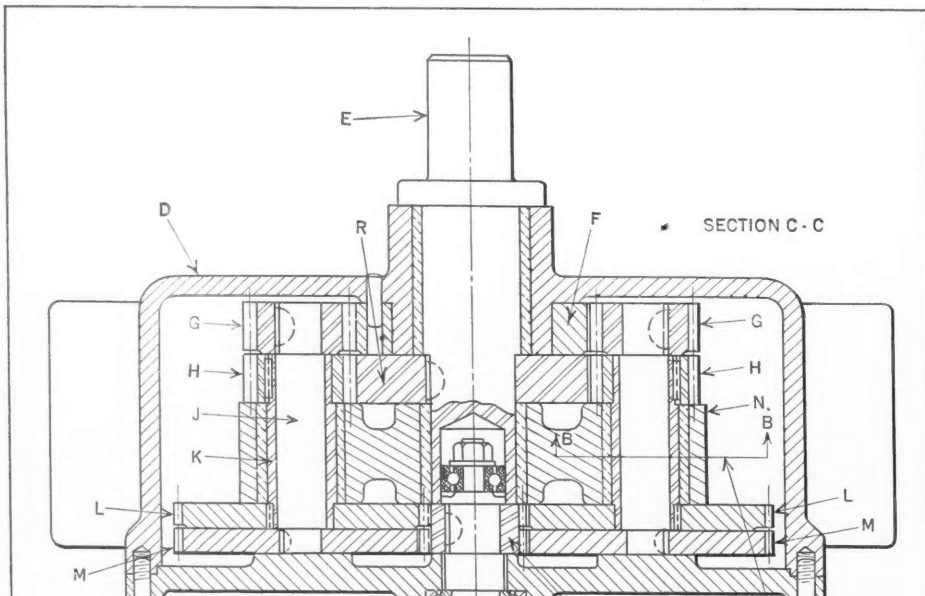
Thus we have the ratio between the driving and driven shafts equals

$$-\frac{341}{64} \div -\frac{1}{80} =$$

$$\frac{341 \times 80}{64} = \frac{426}{1}$$

It should be noticed that the equations for both Q and E are negative; hence their quotient is positive, which means that the driven shaft E runs in the same direction as the driver Q. If the positions of gears L and M are reversed, the same ratio is obtained, but with a negative sign, as will be found by working out the example as in the first case.

The effect obtained by making P in two pieces, with 31 teeth for the lower half to match the normal 81-tooth gear M, and 32 teeth in the upper half to match L with 80 teeth, will be to greatly reduce the ratio. Working out this example by the same method as was used for the first example shows the ratio to be 121.5 to 1.

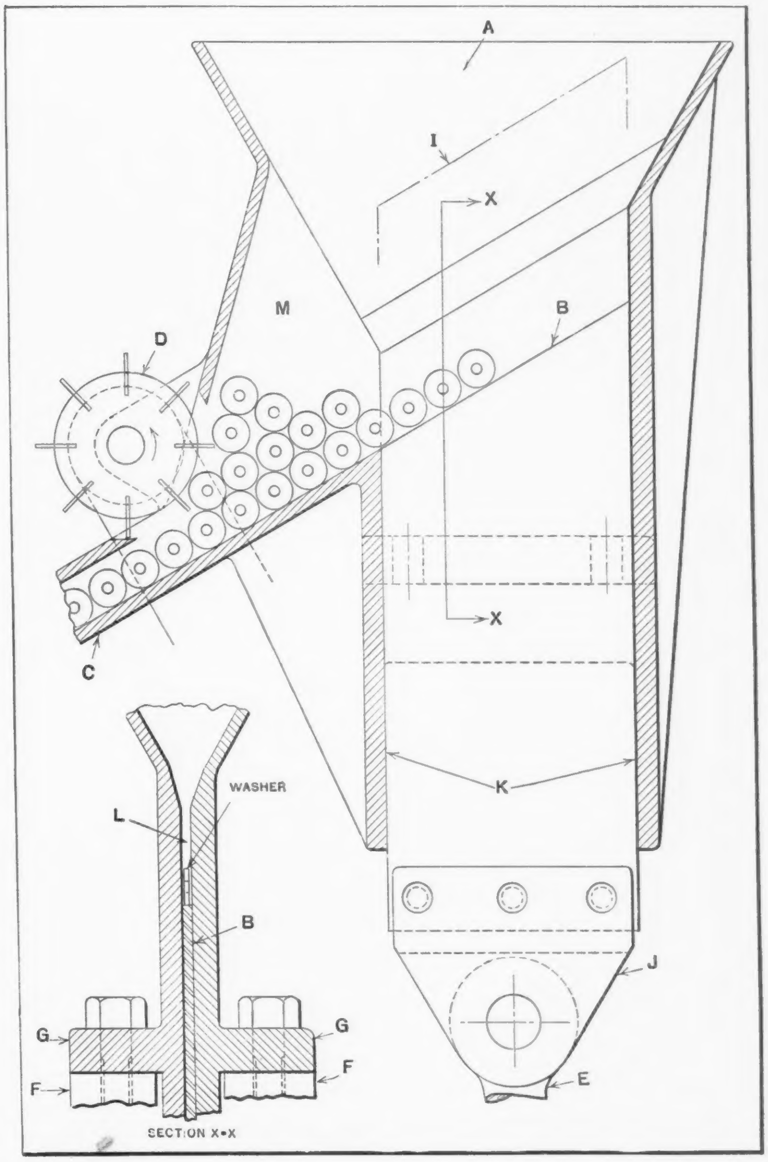


High Ratio Speed Reduction Mechanism of Compact Design

Changing the pinion P to 33 teeth throughout, and making M and L 79 and 78, respectively, gives a ratio of 403 to 1, which is only a small change from the ratio obtained with the arrangement given in the first example. In fact, this change actually amounts to a reduction of a little over 5 per cent. Changing the number of teeth in P to 31, and in M and L to 81 and 82, respectively, causes the ratio to go up only about 6 per cent.

Remarkable changes in the ratio take place when changes are made in gears F, G, H, and R. If F is made with 51 teeth and G with 19, the ratio drops to 66.5 to 1. If R is changed to 51 teeth and H to 19, the ratio drops to 99.5 to 1, and the driven shaft runs in the opposite direction from the driver. On the other hand, if F is changed to 49 teeth and G to 21, the ratio becomes 89.2 to 1, with the rotation of the driver opposite that of the driven shaft. If R is made with 51 teeth and H with 21, the ratio drops to 57.8 to 1 and both shafts revolve in the same direction. It is evident that slight changes in the ratio can be made only by manipulating gears L, M, and P.

The general construction of the speed reducer is shown quite clearly in the illustration. The low-speed shaft E runs in a bronze-bushed bearing, and the drive can be taken off to one side—that is, with a chain or gearing, if necessary. The high-speed shaft Q, in this case, was designed to be coupled directly to a motor. If it were necessary to drive shaft Q with a chain or gears, the double-row ball bearing would probably have to be split up into two bearings, one being arranged as in this design, and the other located close to the end of the shaft to take the radial load of the chain or gear. The method of mounting will naturally depend on conditions. In the application described, the case D was fastened to two channels running parallel with the shafts, legs S being provided for that purpose.



Hopper of Simple Design for Feeding Washers to a Dial Press

Hopper for Feeding Washers to a Dial Press

By J. E. FENNO

The hopper here illustrated was designed for feeding special brass washers to a dial press, where they are assembled to electrical toggle switch levers. As slide B passes up and down through the mass of washers at A, some of the washers drop into spaces L or M, which are slightly wider than the washers, and roll down the incline at the top of the slide and thence into the chute C. The slide is shown in its lowest position, the highest position being indicated by the light dot-and-dash lines at I.

The reciprocating movement of slide B is obtained from a crank which is connected to the bracket J on the slide by the link E. The washers are prevented from jamming at the entrance to the chute by the wheel D. This wheel, revolving in the direction of the arrow, is driven by a sprocket and chain from the hopper crankshaft, and is equipped with eight flat spring projections which agitate the washers sufficiently to insure a uniform flow down the chute.

The sides of the hopper are carried down at K to resist the side thrust of the slide set up by the hopper crank. Any dirt which may enter the hopper will pass out through the chute. The lugs G, cast integral with the hopper, provide a means for fastening the hopper to the bracket F on the press.

* * *

Sound engineering without sound economics is like an engine without steam.

Automatic Loaders for Individual Machines

Hydraulic and Pneumatic Loaders that Save Time and Insure Safe Operation

By CHARLES O. HERB

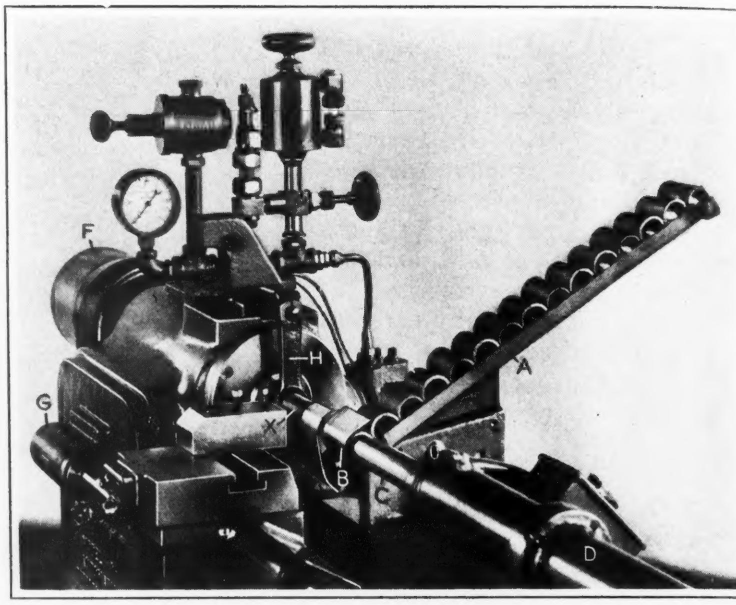


Fig. 1. Air-operated Equipment for Loading and Unloading Bushings on an Expanding Arbor in 1/2 Second

EQUIPMENT devised by the Seneca Falls Machine Co., Seneca Falls, N. Y., for automatically and simultaneously loading and unloading all machines of a group, was described in an article published in June MACHINERY, page 721. In that article mention was made of the fact that the same company, during the last few years, had applied a number of automatic loading devices to individual machines. The features and advantages of several such applications will be discussed here.

Automatic loading equipment provided on a machine that is employed for turning bronze bushings is shown in Figs. 1 and 2. The bushings have been reamed and grooved internally when they come to this machine, and can therefore be held accurately for the operation by means of an expanding arbor. They are merely placed on chute *A*, down which they roll until stopped by a curved flange *B*, the loading plunger *C* being in the withdrawn position, as illustrated in Fig. 1. Flange *B* positions the lowest bushing on the chute in line with the expanding arbor of the machine and the loading plunger.

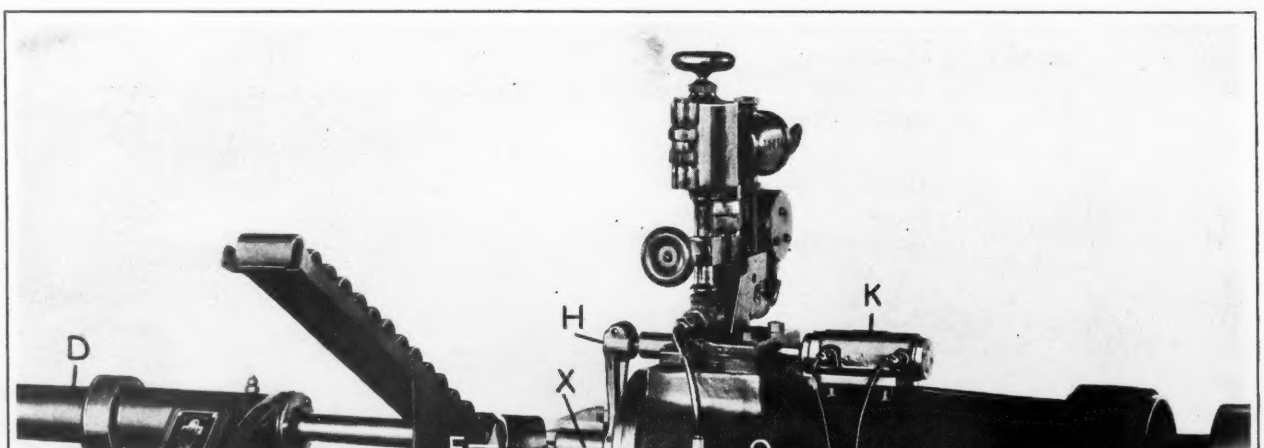


Fig. 2. Rear View of the Bushing Machine, Showing the Cams that Control the Complete Operation through Air Valves

At the beginning of each machine cycle, a valve that controls a piston in air cylinder *D* advances plunger *C*, thus pushing a bushing on the arbor. The front end of the plunger is a loose fit in the bushings for a distance of about 1 1/4 inches, and consequently, the bottom bushing on the chute remains stationary when the plunger advances until the shoulder on the plunger touches the bushing. Then the bushing is carried forward with the plunger and slid on the arbor. In doing this, the front part of the plunger telescopes into the shoulder portion, so that the bushing is secured for its full length on the arbor.

The bushing is seated on the plunger by the action of a hinged plate *E*, Fig. 2, which exerts sufficient pressure against the front edge of the bushing to hold it stationary until the plunger enters it. Then the pressure of the plunger overcomes the resistance of the hinged plate, forcing the plate downward and permitting the bushing and plunger to pass.

When the bushing has been pushed on the arbor, as shown at *X*, the arbor is automatically expanded by the air cylinder *F* at the left-hand end of the headstock. The loading plunger then returns to the position illustrated, the work starts rotating, and the tool-slide advances for the cut. The carriage is advanced by a cam and returned by air cylinder *G* at the front of the machine. When the operation has been completed, the tool-slide is returned to the front of the machine, the arbor is contracted and stripper *H* is moved forward through the action of air cylinder *K*, Fig. 2, to push the work off the arbor. The work drops on chute *J* and rolls into a tote box. Three cams mounted on a shaft extending from the back of the machine, as illustrated at *M*, operate valves in housing *O* at predetermined intervals for actuating the pistons of the air cylinders.

This machine is adjustable to permit handling parts of various sizes. On bronze bushings 1 5/32 inches outside diameter and 2 inches long, an average production of 1010 pieces per hour is obtained. The actual loading and unloading time for each piece is approximately 1/2 second.

Automobile Pistons Turned at the Rate of 120 per Hour

Bohnalite automobile pistons are finish-faced on the closed end, grooved, finish-turned on all lands, and semi-finish-turned on the skirt end in one operation in the machine illustrated in Figs. 3 and 4. Through the use of tungsten-carbide tools and the automatic loading and unloading equipment illustrated, a production of 120 pieces per hour is obtained with one machine. The reloading time is about 5 seconds. The entire work of the operator consists of keeping the loading chute full of pistons. He is able to tend five machines of this type.

Fig. 3. Automatic Piston Loader in the Act of Taking a Finished Piston from the Machine and Carrying a New Part into Position for the Operation

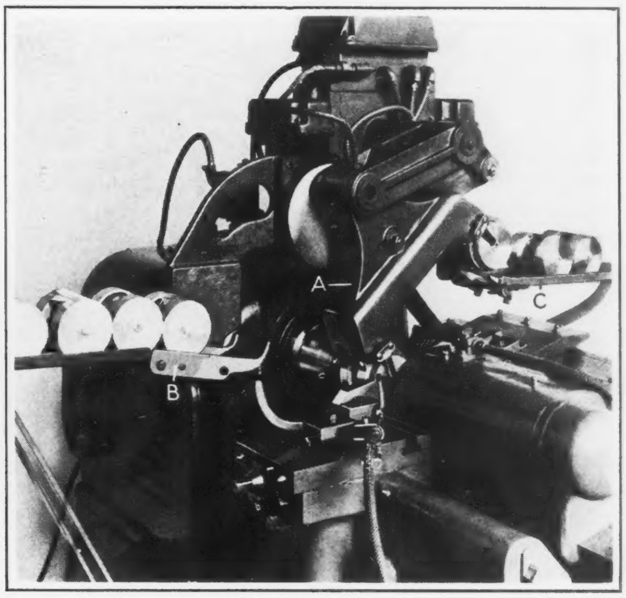


Fig. 4. Placing the Finished Piston on the Discharge Chute and a New Piston into Line with the Tailstock Center and Headstock Driver

The loading and unloading device applied to this machine embodies important improvements over the equipment illustrated in October, 1929, MACHINERY, page 89. The device is now hydraulically operated. When an operation is in progress, the work transfer member *A* is in a neutral position, with its lower portion horizontal so that the fingers at both ends clear the work piece that is chucked in the machine and also the parts on chutes *B* and *C*. As soon as the operation is finished, the tool-slides of the machine withdraw from the work and the work stops

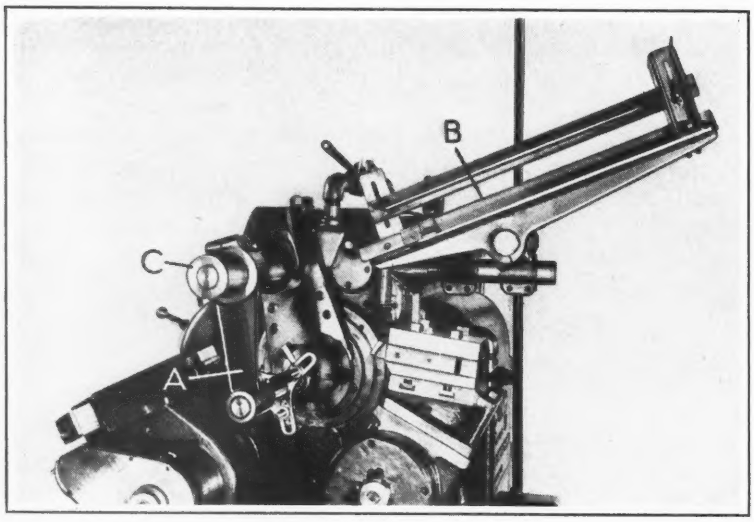


Fig. 5. Loading Device which is Given a Swinging Motion and also Moved in and out through the Action of Hydraulic Cylinders

rotating. Then member A swings into the position illustrated in Fig. 3, the fingers at the right-hand end slipping over the piston that is chucked in the machine and the fingers at the left-hand end slipping over an unfinished piston on chute B. A hydraulic cylinder within member A then closes the fingers firmly on the pistons. The tailstock center and the driver on the headstock next withdraw and release the finished piston.

As soon as this action has occurred, member A is swung into the position shown in Fig. 4, the finished piston being lifted on chute C and the unfinished piston being moved into line with the tailstock center and the headstock driver. The center and driver then advance to support the new piston, after which the fingers of member A are opened, releasing the pistons. The transfer member A finally returns to its neutral position, the work starts rotating, and the tool-slides advance for the cuts.

In order to clear the various machine members and the chutes, it is necessary to impart vertical and sidewise movements to member A, in addition to the swinging movement. A grooved cam gives the desired action.

Electric Switches Control All Movements

All movements of the machine and of the loading and unloading device are controlled by electric switches which operate solenoids in boxes mounted on top of the machine. These solenoids operate hydraulic valves to produce the various machine and loader movements. Complete safety is afforded, because no movement can be made until each preceding movement has been successfully performed. If the movement of any member is interfered with, the switches will automatically stop the machine.

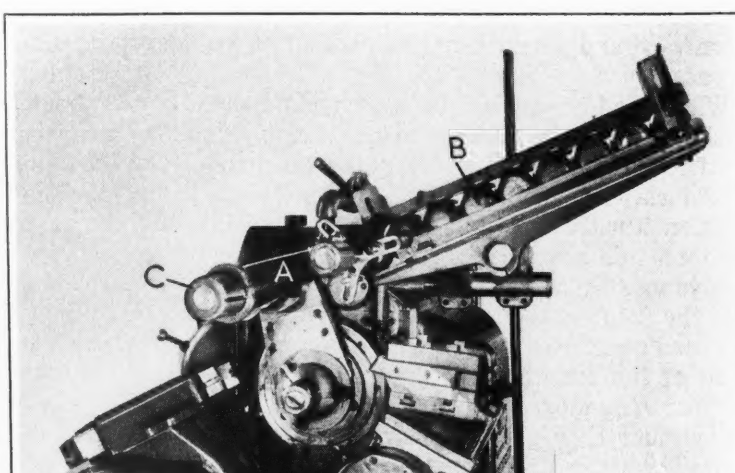
Swinging and In-and-Out Movements Combined in One Loader

In loading roller-bearing cup forgings into the automatic lathe shown in Figs. 5 and 6, it is necessary to slip the forgings on an expanding arbor for the operation. This requires an in-and-out movement of the loading arm A, as well as a swinging movement to carry the work from chute B into line with the machine spindle. The swinging movements are accomplished by means of a hydraulic cylinder on top of the machine. The piston-rod of this cylinder has rack teeth which engage pinion teeth cut on shaft C. Thus, as the piston-rod is actuated to the right and left, arm A is swung clockwise and counter-clockwise, respectively. Shaft C is moved axially by means of a second hydraulic cylinder to provide the in-and-out movements of arm A.

The position of the loading arm as it advances a work piece on the arbor is shown in Fig. 5. After the piece has been placed on the arbor, the arbor expands to grip it and then the loading arm withdraws to clear the work. Immediately the work starts rotating and the tool carriages rock in to take the cuts. When arm A reaches its outer position, it swings upward into the position shown in Fig. 6 and then moves toward the machine to slip the work transfer fingers over the bottom part in chute B. The bottom piece is always held in the proper location by means of a stop. Arm A then withdraws again from the machine and swings down into the position shown in Fig. 5, ready to slip the next part on the arbor.

As each piece is finished, the arbor contracts and a stripper pushes the part off the arbor into a trough that leads to a tote box. The stripper re-

Fig. 6. View of the Machine Just after the Loading Arm Has Taken a Cup Forging from the Chute and Brought it Forward to Swing it into Line with the Machine Arbor



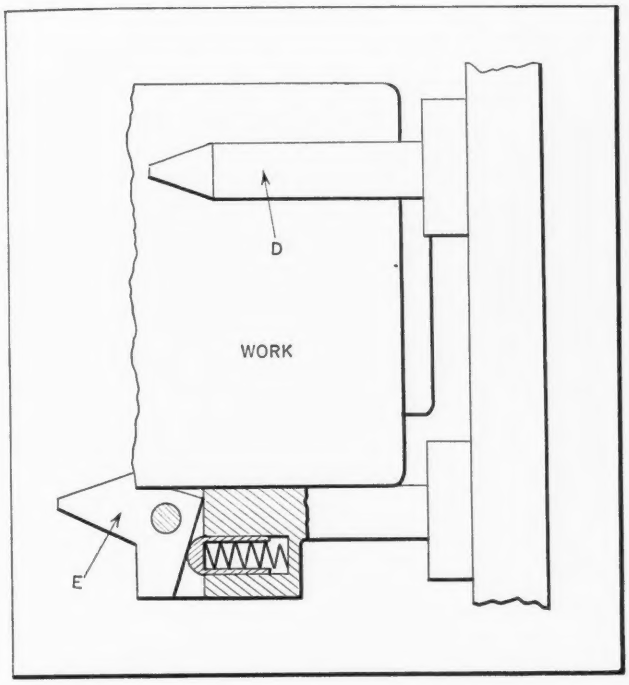


Fig. 7. Two of the Work Transfer Fingers are Conical-end Pins, while the Third has a Hook for Holding the Part on the Loading Arm while being Transferred

turns to its normal position before arm *A* advances to load the next piece, as already explained. A feature of this machine is that, during the cutting, the trough on which the finished part drops is open to allow chips to fall through and into a truck.

The work transfer fingers on arm *A* consist of two adjustable pins *D*, Fig. 7, which are made cone-shaped at the forward ends to slip over the work pieces. There is also a third adjustable finger which has a hook *E* that holds each piece securely between the fingers while it is being transferred from the chute to the machine arbor. As this hook comes in contact with the work when the fingers are advanced on a part in the chute, it is swung back and remains in that position until it passes the forward end of the piece. Then it quickly clamps over the end, as shown. The opposite end of the work is supported by a spring plunger. Hook *E* is swung back to release the piece when the work is pushed on the machine arbor.

Four hydraulic cylinder and piston units operate the loading device, the expanding arbor, and the stripper, and there are other hydraulic units that actuate the tool-bars. The production on the operation illustrated, which consists in turning cups 3 3/16 inches outside diameter by 3 1/4 inches long, and cutting them into three roller bearing races, averages 375 pieces per hour. The actual reloading time per cup is five seconds.

This loading equipment is designed to handle pieces from 5/16 inch in diameter by 5/8 inch long up to pieces 5 inches in diameter by 5 1/2 inches long. The time for adjusting the loader to suit different sized parts is not over fifteen minutes.

Good Designers and Fine Drawings

As an instructor in mechanical drawing, the question "Is the Man Who Makes the Finest Drawings the Best Designer?" interests me. I tell my students that the object of their work is not to make drawings, but to present ideas by means of drawings so that the ideas can be readily understood. The ideas must be practical, economical in execution, and involve, as far as possible, standardized construction with safety of operation. No time should be put on the drawing merely to make it look "nice," but time may well be spent in making it clear.

Of all the students coming under my direct observation in the last ten years, only a small percentage have been potential designers, although many of them were able to make excellent drawings.

J. Homewood

After reading all the comments published in Machinery on the question "Is the Man Who Makes the Finest Drawings the Best Designer?" the writer is of the opinion that a very important point was missed. In most plants, the designer is so valuable that he should not waste his time making drawings—good or otherwise.

The designer should make a comprehensive sketch of his ideas and turn it over to a draftsman, who usually is more competent in making shop drawings than the designer. This method costs the employer less than when the designer makes drawings for shop use. The one important point is that the designer knows what he is building, and is therefore likely, in making the drawings, to leave too many things to be taken for granted. The draftsman, on the other hand, working from a sketch, will think along the same lines as the shop men. He does not know what it is all about, and therefore will ask questions and thus make a more understandable drawing. This plan is the most successful one that the writer has ever come in contact with. Charles R. Whitehouse

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Most of the letters to the Editor relating to whether the man who makes the finest drawing is the best designer have failed to take into consideration the obvious fact that mechanical drawing is a universal shop language, and therefore a means of self-expression regarding things mechanical.

The man who can express his thoughts most fluently need not necessarily be pedantic, so long as his meaning is made clear. Many of our famous authors are atrocious penmen, and so are many famous designers. That does not detract from the value of their creations.

While we all like to see neatly executed drawings, we cannot blind ourselves to the fact that no matter how "artistic" a drawing may be, if a worthwhile idea is lacking, it is, after all, just a drawing. In designing, the idea is the thing—first, last, and all the time. Robert S. Alexander

The Shop Executive and His Problems

Superintendents and Foremen are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations

WITH many executives, the practice of putting things aside to be done at home becomes habitual. Management, which at one time looked with an approving eye upon the faithful employe taking work home, no longer is quite as appreciative of this effort. Night work in any organization is occasionally necessary, but to take work home regularly indicates that something is wrong either with the individual or the organization. The man who makes a practice of taking work home either has his job poorly organized or is attempting to carry too much of a load.

Although a man may conscientiously believe that he is serving his organization to advantage by doing night work, it is generally the fact that he returns to work the next day with overwrought nerves. In the long run, both the individual and the company suffer. HARRY KAUFMAN

Selecting the Supervisor

The statement on page 612 of April MACHINERY that a supervisor should combine a liberal measure of both practical and technical training cannot be contradicted. Perhaps it is still more important, however, that the supervisor have a good working knowledge of human beings. Such knowledge is just as essential as knowledge of physical laws and engineering practice.

It is important for an executive to have the ability to decide promptly and definitely. No supervisor can exercise authority effectively without confidence in himself. Without such confidence, it is impossible to make clear-cut decisions. Nothing is more fatal to successful leadership than hesitancy and indecision.

The most successful supervisor is not the man who tells the workmen how each detail of the work should be done, but rather the man who acts as a kind of court of review or of final approval, passing upon the methods suggested by those who are to carry out the work. A. EYLES

Leaving the Foreman Free to Do Important Work

Referring to the article in January MACHINERY, page 336, relating to the foreman's work, it may be well to emphasize that the efficiency of a foreman may be measured in other ways than by job knowledge and charts. The proper guiding of employes calls for human contact. The biggest job of the foreman is still that part that has to do with the human factor. A foreman's office is only a part of his operating field. The management knows that the foreman who clearly interprets company policies—and some are not written down—and puts them into effect with the least disturbance must have time to think about his whole job.

The safety of employes is another part of the foreman's work that is just as important as preventing scrap, maintaining quality of work, and obtaining high production. Experience has shown that unsafe working conditions and habits can best be eliminated if the foreman will take a personal interest in his men.

If the foreman is of the right type, the men will seek his opinion and advice when in difficulty. He must remember that the things that seem trifling to him often appear to be of great importance to the employe. The foreman is the connecting link between management and men, and any arrangement in his department that frees him from that responsibility, to do work that he or some superior may consider more important, should be watched very closely at the start. C. E. HENDRICKS

The Selection and Training of Foremen

Commenting on the editorial on page 580 of April MACHINERY relating to the training of apprentices and foremen, the writer would like to emphasize the importance of training foremen in the handling of men. The foreman should also be impressed with the necessity of continued study and of the development of leadership qualities. There are many firms that give foremanship training courses; but even after a man has finished such a course and has been made foreman, he must continue to be a student of the advances in his own line of work and of the men working for him.

Not enough stress is laid on the fact that the successful supervisor is one who keeps abreast of the times and who is able to understand the troubles of the men working for him. Employers must realize that foremanship training courses are of little avail unless the foreman continues to be a student as long as he is engaged in industrial work. He must keep in touch with changes in tools, methods, and machinery. Unless he does, he will not remain an asset to the company employing him. Some foremen are asked to report at intervals on new machines and methods that they have studied in technical journals. CHARLES R. WHITEHOUSE

Special Tools and Devices for Railway Shops

Recommended by Railway Shop Superintendents and Foremen

Cross-Compound Air Pumps Repaired by Grinding

Large economies have been effected by the use of the grinding process in repairing the cross-compound air pumps used on locomotives of the Canadian National Railways. Formerly, it was the practice to rebore the pump cylinders on radial drilling machines. However, as the difference between the maximum and minimum diameters of any cylinder could only be 1/4 inch, this allowance was soon used up because of the amount of stock necessarily removed in boring. Hence, the pump soon had to be scrapped.

The truing of these cylinders is now done by grinding. With this method, the stock removal can be controlled closely and, consequently, the pumps remain in service much longer than before. It is the practice to grind both cylinders of a pair simultaneously in the manner illustrated, which shows an operation in the Stratford, Ontario, shops of the railway system mentioned.

Both grinding heads of this machine are mounted on carriages that have a longitudinal movement, but are fixed transversely. Thus the grinding spindles are always in line with each other, which insures that the cylinders will be in accurate alignment. When a pair of cylinders has been ground to the desired accuracy, the table of the machine is adjusted crosswise to bring the next pair of cylinders into line with the grinding heads.

The grinding heads are fed hydraulically along the bed during the operation at the rate of about 36 inches per minute. The grinding wheels, of course, revolve eccentrically. All dust is sucked from the cylinders by two fans at the back of the

Opposite Cylinders of a Pair on Cross-compound Air Pumps are Ground Simultaneously

machine, there being a small hole at the inner end of each cylinder to which a dust cable can be connected. On the job illustrated, the large cylinders are approximately 14 1/2 inches in diameter, and the small cylinders 8 1/2 inches in diameter.

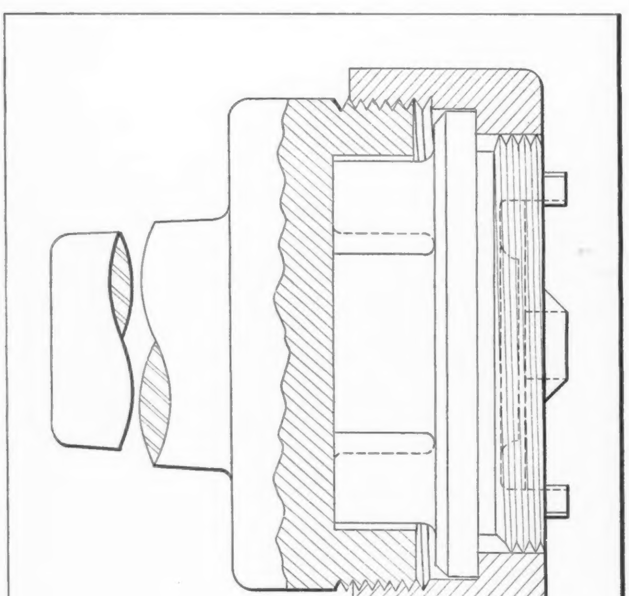
The same grinding machine is also used for finishing other parts, such as the steel liners of Diesel engine cylinders. For those jobs, of course, only one grinding head is used at a time. O. H.

Lathe Mandrel for Reclaiming Air-Pump Valve Caps

By EDWIN G. JONES
Atlantic Coast Line Railroad, Tampa, Fla.

Air-pump valve caps are usually reclaimed and used many times before they are scrapped. The constant hammering of the valve against the valve stop of the cap causes the stop to become battered and worn. In railroad shops, these caps are ordinarily reclaimed by hammering the worn stop flat with a hammer or some other flat-surfaced tool. This method, however, does not insure a true square surface. Another method is to hold the valve cap in a lathe chuck while squaring up the stop. Although this method is accurate, it requires a good deal of time.

This job can be done more rapidly by means of the mandrel shown in the illustration. It is designed



Mandrel for Squaring up the Stop on Air-pump Valve Caps

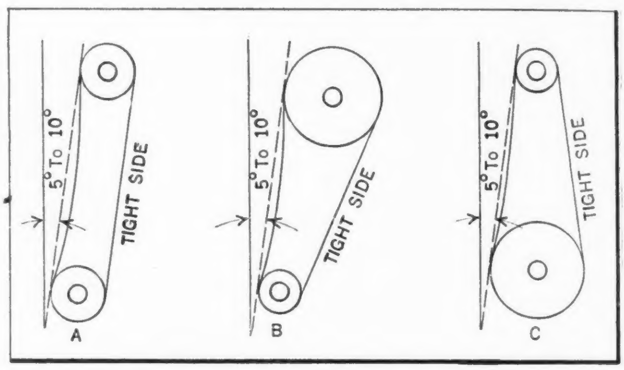
for intermediate valve caps, but the same design can be used for large valve caps. The mandrel is made of soft steel and the shank is machined to fit the tapered hole in the lathe spindle. The clamping nut is also made of steel, and its outer surface is knurled to produce a convenient hand-grip. This nut holds the valve cap accurately and securely in position for machining the stop. All battered places on the tops of the caps should be filed to produce a true square surface before the cap is mounted on the mandrel.

* * *

Relation of Belt Angle to Belt Contact in Vertical Drives

By W. F. SCHAPHORST

An important consideration in laying out belt drives that are nearly vertical is the determination of the smallest angle with the vertical at which the



Minimum Angle of Loose Side for Three Common Belt-drive Lay-outs

belt will operate efficiently—that is, without sagging away from the lower pulley.

Three conditions of this type of drive varying only in the diameters of the pulleys are shown diagrammatically in the illustration. In every case, no trouble will be experienced when the best grade of two-ply belting is used, if an angle of from 5 to 10 degrees with the vertical is maintained and the tight side of the belt is on the side shown. This angle should be increased for drives which are pulsating as in the case of reciprocating pump drives.

If, however, the positions of the slack and tight sides are reversed, it is advisable, in cases *A* and *B*, to use idler or wrapper pulleys for obtaining the proper belt contact on the lower pulleys. In case *C*, this is not necessary, as the same condition exists regardless of which side the slack part of the belt is on.

The difference in pulley diameters of each drive and the center distance are not considered here, as these recommendations apply only to drives in common use in which these factors may be disregarded. Another important point to consider is the use of belts of ample width on pulleys of ample diameter.

* * *

A prominent engineer advises college graduates to remember that the words "commencement exercises" indicate that they are just beginning to learn.

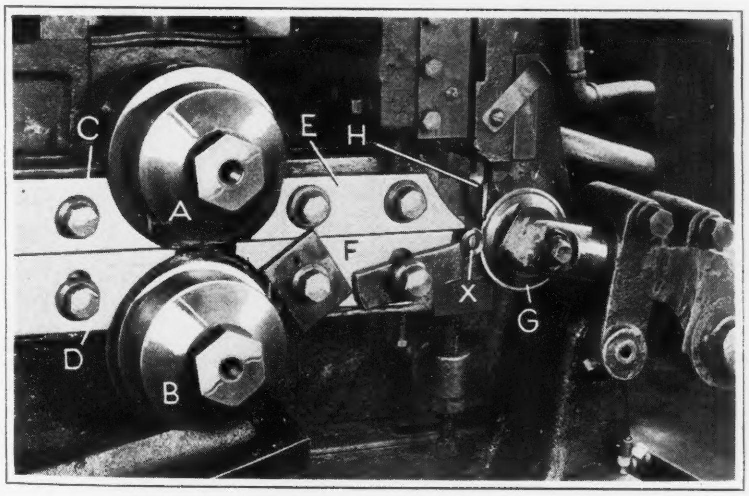
Tungsten Carbide Used for Resisting Abrasion

In the operation of special machines used by the National Lock Washer Co., Milwaukee, Wis., for producing lock-washers, considerable trouble was experienced because of excessive wear on a steel block over which the spring steel stock was fed. The illustration shows a close-up view of one of these machines. The stock is drawn by rolls *A* and *B* between high-speed steel blocks in back of guards *C* and *D* and advanced between two other blocks in back of guards *E* and *F* to point *X*, where the washer is produced.

The washer is formed as the force exerted by rolls *A* and *B* presses the stock against roll *G*. The resistance offered by this roll causes the stock to coil around a mandrel as shown. When the stock has been coiled the proper amount, the ram of the machine descends and the cut-off tool *H* severs the washer from the stock. Tool *H* operates from 270 to 570 times per minute, depending upon the size of washer being made.

During this operation, considerable pressure is exerted on the guide block in back of plate *E* as the stock slides under it and at the same time is forced upward against it by the resistance offered by roll *G*. Then, too, the sudden release of the stock when the washer is cut free, has some effect on the front edge of the block.

The combination of these factors caused the hardened high-speed steel blocks to wear rapidly—they lasted from five to six hours only between regrinds. Stellite was adopted for this block and gave a service of from twenty-five to thirty hours between regrinds. Finally, blocks with Carboloy inserts on the wearing surfaces were tried out. These blocks have lasted 1200 hours without regrinding, the wear at the end of that time being about 0.006 inch on the tip where it is greatest. Obviously, the grinding time has been greatly reduced.

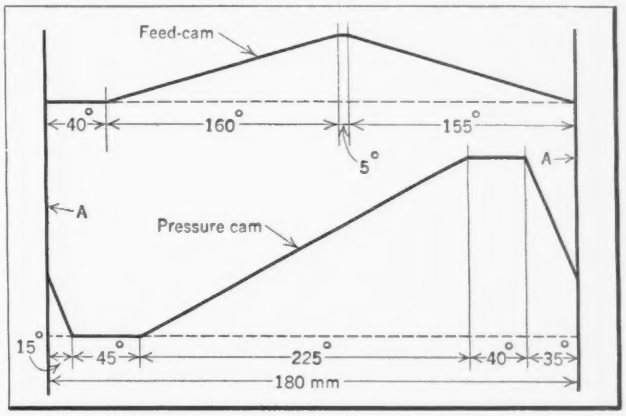


In Making Lock-washers from Spring Steel Stock, Trouble from Excessive Wear on a Guide Block was Overcome by the Use of a Block with Carboloy Inserts

Metric Scale Aids in Designing Cams

By WALTER A. SIMOND

In designing a machine having more than one cam movement, the work is greatly facilitated if a graphic representation is made first to show the relative cam movements. A simple means of doing this is indicated in the illustration. Here is shown the graphical lay-out of two screw machine cams. Assume that both cams rotate at the same angular velocity. To lay out these cams, first draw the two parallel lines *A*, exactly 180 millimeters apart. This distance represents 360 degrees, or the angular movement of the cams during one revolution. Therefore, a distance of 1 millimeter along either of the dotted base lines represents a 2-degree angular movement of the cam.



Simple Method of Showing Relative Movements of Cams by Using Metric Scale

Metric measurement is used here, because, with fractional parts of an inch, a suitable scale is not available. With this arrangement, any point on one of the irregular lines representing one cam follower movement can be instantly compared with the corresponding point on the other cam follower line by simply holding a straightedge at the proper point and parallel to the vertical lines.

This method is also applicable in laying out a single cam, the angular position of the follower being quickly found by measuring along the dotted base line.

* * *

A building brick has been developed that weighs only one-fifth of an ordinary brick. Prepared from a certain type of clay, this brick will float in water and is said to continue to do so even after having been immersed in water for a year. The brick possesses good heat-insulating qualities and is of great strength. Bricks of this type can, of course, be laid with less expense and less physical effort than the regular kind of brick.

External and Internal Broaching of Free-Wheeling Shift Levers

Two broaching operations are performed on the free-wheeling shift lever used in Hudson automobiles. One of these consists of broaching the two

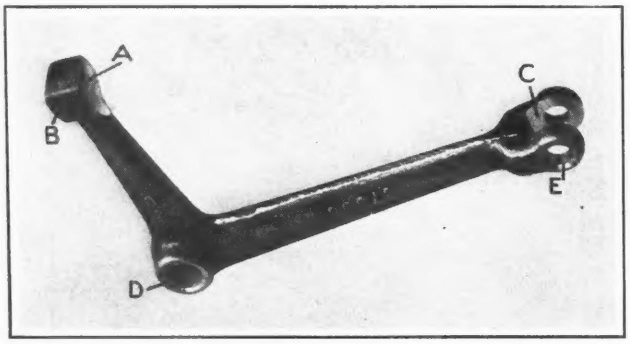


Fig. 1. Free-wheeling Shift Lever, Both Ends of which are Broached

curved surfaces *A* and *B*, Fig. 1, to definite radii and to a specified width within a tolerance of 0.002 inch. The other consists of cutting slot *C* in the solid end.

Both operations are performed in the Oilgear Twin-Ten hydraulic broaching machine shown in Fig. 2. For the first operation, the part is placed in the right-hand side of the machine, as illustrated at *X*, with the previously drilled hole *D*, Fig. 1, seated on an accurate plug and the drilled hole *E* of the yoke placed over a second plug so as to locate the end to be finished correctly relative to the two broaches.

For the second operation, the lever is placed in the left-hand side of the machine, as shown at *Y*, Fig. 2. It is accurately positioned for height by inserting a sliding plug *F*, in hole *D*, Fig. 1. As the broach is pulled through the work, the lever is drawn back against stops so that it is held in a true vertical position.

In taking this cut, stock is removed to a depth of about 9/16 inch. The production on both operations averages eighty pieces per hour, one operator tending both sides of the machine.

* * *

An interesting plan for making use of the roadbeds of such railroads as may not prove sufficiently profitable at the present time to continue in operation has been proposed by S. R. Teager, management engineer of Canton, Ohio. Mr. Teager proposes that these roadbeds be converted into express highways. This might prove a solution of some of the problems facing certain railroads. These highways would be toll roads, so that they would continue to bring a return on the investment in the railroad permanent way.

The Use of Trigonometric Functions for Laying out Angles

By FRANCIS M. WESTON

Laying out angles by means of a table of natural tangents is far more convenient than using sines as described on page 766 of June MACHINERY. The tangent method, fully described in MACHINERY'S HANDBOOK, combines in one operation the best features of the two sine methods given: It provides for laying out an angle with its vertex at a given point, and it locates two points for determining the desired line instead of only one point and the arc of a circle.

Briefly, the method of using natural tangents is as follows: Draw a base line through the given point. Lay off from this point a length of 10 inches (100 inches if extreme accuracy is desired). At the second point thus found erect a perpendicular to the base line. Lay off on the perpendicular from its intersection with the base line a length equal to 10 times (or 100 times, as the case may be) the natural tangent of the desired angle. Connect the point thus obtained with the first given point; then the new line will be at the desired angle with the base line, and the vertex of the angle will be at the given point.

* * *

A method employed to reduce distribution expenses and to obtain a more complete and profitable sales coverage in the industrial marketing field is presented in a booklet entitled "A Basis for Supervision of Industrial Sales Personnel," which is distributed by the Department of Commerce, Washington, D. C.

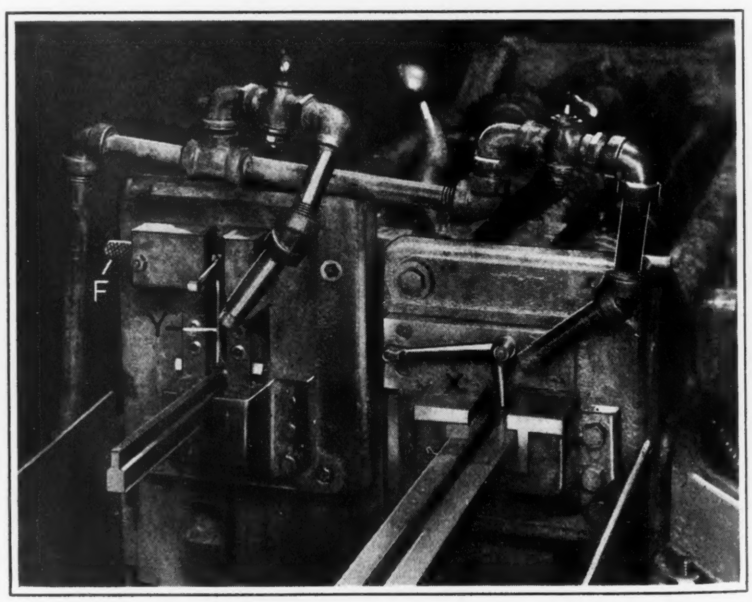


Fig. 2. Two Broaching Operations on the Free-wheeling Shift Lever are Performed in a Duplex Type of Machine Tended by One Operator

A Simple and Accurate Way of Handling Angular Work

Method of Positioning Locating Plugs on the Angular Surface of a Drill Jig

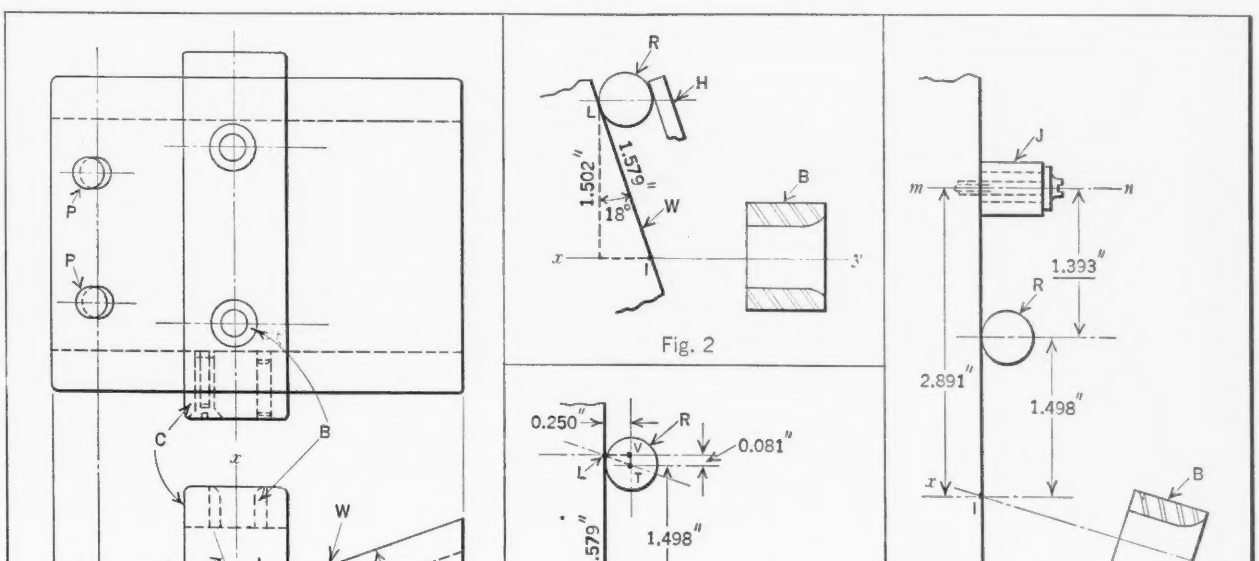
By WALTER WELLS

THE toolmaker is often confronted with angular lay-outs in positioning bushings and plugs in drill jigs. If a high degree of accuracy is unnecessary, as in the location of oil-holes, or if the extreme inclination of the base lines tends to make precision superfluous, the job can be performed with sufficient accuracy by working from intersecting lines scribed with a height gage. However, when the highest degree of accuracy is required, particularly when the base lines are more nearly at right angles, it is necessary to resort to precision measurements and shop trigonometry. The lay-out described here presents a problem of the latter kind.

The nature of this job is shown by the plan and elevation views in Fig. 1. The two locating plugs *P* fit into corresponding holes in the pieces to be drilled. The bushing plate *C* is fitted with bushings *B*. Slip bushings (not shown) are also fitted in bushings *B*. The scraped surface *W* on which the work is to be held is at an angle of 18 degrees with the base *S*. The center line x–y of the drill bushings intersects the plane of the locating base at the point *I*. The distance from this point to the center line m–n of the locating plug *P* is 2.891 inches.

The placing of the bushing plate and the spacing of the bushing holes present no unusual problem. Dowels were used to hold the plate and its brackets in position. The accurate location of the plugs *P* in the position indicated by the dimension 2.891 inches is the problem to be solved. It is obvious that the position of plugs *P* cannot be determined with the jig strapped in only one position on the angle-plate. An accurately ground cylindrical piece must be used in making the required measurements. Also, the jig must be clamped on the angle-plate successively in two different positions.

Figs. 2, 3, and 4 show partial views of the jig as clamped on the angle-plate for obtaining readings with the height gage and test indicator. Enough of the jig outline is included in Fig. 2 to show the first clamping position and to indicate how the preliminary calculation is made. The bushing is lined up so that its center line x–y is parallel to the surface plate. Meanwhile, the rod *R* has been lightly attached to the surface *W*, approximately parallel with the surface plate and at any position



Figs. 1 to 4. Method of Locating Plugs P on Angular Surface W of Drill Jig

that will not interfere with either the bushing plate or the points where the plugs are to be located. The rod R is next paralleled up very accurately with an indicator and clamped securely in place.

A height gage reading is next taken from the center line to the rod R. Proper deductions and additions are, of course, made for the half diameters involved, thus obtaining dimension 1.502 inches. This dimension could have been more or less, any convenient position meeting requirements. From the two elements of the triangle that are known, the angular distance IL is next found by trigonometry. Thus, we have $IL = \frac{1.502}{\cos 18 \text{ degrees}} = 1.579$ inches.

The jig is next shifted to bring the base line W exactly perpendicular, as shown in Fig. 3, with the rod R remaining horizontal. This shift in the position has the effect of swinging the theoretical center of the rod downward below the point L, which merely serves as one of the vertices of the triangle just solved. Thus the vertical dimension to the center of the rod R will be less than it was before the position was changed. The small triangle LTV must therefore be solved.

The known radius of rod R is 0.250 inch, and the angle VLT equals 18 degrees, each of its sides being perpendicular to the sides of the 18-degree angle in Fig. 2. Thus $VT = 0.250 \times \tan 18$ degrees $=$ 0.081 inch. Subtracting 0.081 from 1.579 gives 1.498 inches, which equals the new reading for IT.

The last view, Fig. 4, simply gives the final step in making the lay-out to suit the total dimension 2.891 inches for the center-to-center distance given in Fig. 1 or on the working blueprint. It is now only necessary to subtract the new reading acquired in the second step, namely 1.498 inches, from the total dimension 2.891 inches. This gives 1.393 inches, which is the required measurement from the center of the rod R to the center line of the locating plugs. In practice, jig buttons J are used to locate the holes for plugs P, Fig. 1. It is understood, of course, that the jig has two locating plugs and two bushings, although in the mathematical considerations, it might appear that we were dealing with one of each.

The principles involved in making this lay-out are typical of a definite class of angular jig work. The use of a cylindrical piece, clamped down at random, to serve as an auxiliary registering point is a method that can be frequently applied to lay-out work in the tool-room.

Speeds and Feeds for High-Speed Steel Milling Cutters

By A. J. SNYDER, Physical Laboratory
Morse Twist Drill & Machine Co., New Bedford, Mass.

There are no exact rules that can be laid down in regard to the speeds and feeds for milling cutters, because so many variables enter into consideration. A statement of certain fundamental facts, however, may be helpful in getting better than ordinary results. In general, the peripheral speed of cutters should vary inversely with the degree of hardness of the material being cut; the harder the material the slower the peripheral speed. It is very difficult to determine the correct feed, as the nature of the material being cut, the depth of cut, and the design of the piece all play an important part. The manner in which the work is anchored or held in place must also be considered. However, the speeds given in the accompanying table will serve as a guide in milling the different materials listed.

Materials such as cold-rolled steel, iron, and heat-treated steel, with hardness values up to 200 Brinell, can be milled successfully at feeds as high as 15 to 20 inches per minute, when the peripheral speed of the cutter is from 150 to 50 feet per minute and the cut from 1/16 to 1/4 inch deep. The table gives cutting speeds that have been found satisfactory for various materials. In cutting cast iron, a peripheral speed of 70 to 90 feet per minute, as given in the table, is safe, unless the castings are thin, in which case they are generally hard or have hard spots. When this is the case, the speeds must be reduced. The speeds given apply to metals that are clean. If the surfaces of the castings contain sand, the speeds must be greatly reduced.

Cutting Speeds for High-Speed Steel Cutters*

Material to be Milled	Surface Speed, Feet per Minute
S A E 3245 Steel	40–45
S A E 3130 Steel	50–60
Annealed Tool Steel	65–70
Untreated Alloy Steel	65–70
Cast Iron	70–90
Soft Machine Steel	90–150
Cold-rolled Steel	90–150
Malleable Castings	90–150
Bronze	600
Brass	800
Aluminum	1000

*For cobalt-steel cutters, increase speed 25 per cent.
Note: This table applies to cuts up to 1/4 inch deep.

* * *

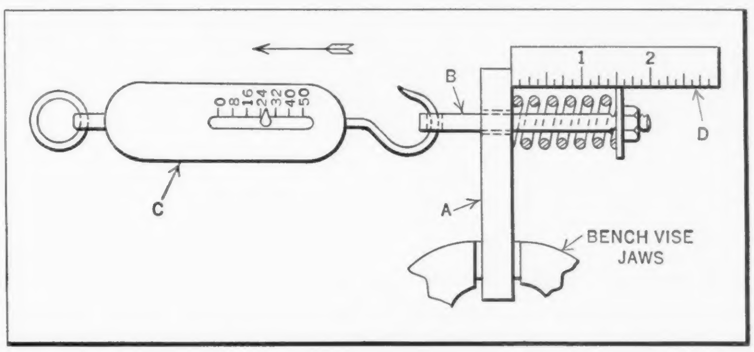
"A good designer," said a manufacturer commenting on a discussion in MACHINERY, "is known by his machines, not by his art work."

Dimensioning and Calibrating Compression Springs

By F. E. FICK

The majority of general and experimental machine shops have no special device for measuring and testing helical springs, and it is for such shops that the equipment here described is intended. When the designer draws up the spring, he either guesses at its performance or figures it out according to formula. In either case, the results may not be very accurate.

The drawings are generally made to show the free length, mean diameter, etc., and it is left to the shop to produce the spring needed by "cut and try" methods. If more springs of the same kind are needed, the workmen simply duplicate a sample of the spring in use, but they have no way of knowing whether any two springs that are the same size and appearance will exert the same amount of pressure at any given length or degree of compression. The simple device shown in the accompanying illustration eliminates this guesswork and enables the mechanic to test springs in such a manner that the pressure exerted, in pounds, at the given length or degree of compression is accurately determined.



Measuring Pressure Exerted by Spring when Compressed to a Given Length

A piece of strap iron *A*, about 3/8 inch thick, 1 1/2 inches wide, and 6 inches long, has a 3/8-inch hole in it about 1 inch from one end, as shown in the illustration. The other end of the strap iron is clamped to a bench vise as shown. A piece of 5/16-inch cold-rolled steel *B* is threaded at one end and has a 3/16-inch hole drilled through the other end. This piece is passed through the hole in the strap iron *A*, as illustrated. A spring scale *C* is then put in place as shown. The spring to be tested is slipped over the opposite end of piece *B* and held in place by a washer and nut. When the spring and equipment are assembled in this manner, the device is ready for use.

The scale *C* is pulled in the direction indicated by the arrow until the spring has been compressed to the desired length, as measured with a rule from the strap iron to the under side of the washer. The reading on the spring scale gives the total pressure, in pounds, exerted by the spring when compressed to the length shown on the rule or scale *D*.

For larger springs, the platform type of scale can be run under the shaper table and blocked up to the necessary height. The spring is then placed on top of the block and the shaper table brought down on the spring. The pressure reading for any desired length of the compressed spring can be easily taken on the beam of the scales.

In this manner, the designer obtains definite information which can be placed on his drawing. With this information, the dimensions of the spring desired and the pressure, in pounds, exerted at a given length can be specified, so that all guesswork will be eliminated. This scheme has helped out the writer several times, and he believes that it will be helpful to others.

* * *

Alloy Wrought Iron

A new development in the manufacture of wrought iron is announced by the Highland Iron & Steel Co., an associate company of the American Chain Co., Inc. Wrought iron is now produced alloyed with nickel, with copper, with nickel and molybdenum, and with copper and molybdenum. The development of these types of wrought iron is the result of several years of intensive research work. It is stated that alloy wrought iron, in general, has a strength 25 per cent greater than ordinary wrought iron. A great increase in fatigue-resisting properties is shown by the wrought-iron-nickel and by the wrought-iron-nickel-molybdenum alloys. The latter alloys have shown an increase in strength of from 40 to 50 per cent over ordinary wrought iron.

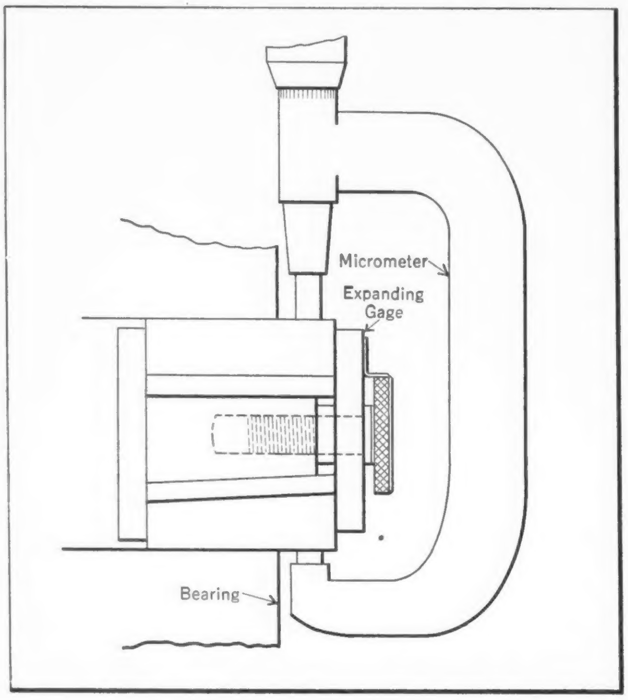
* * *

Weighing Loads While Being Lifted or Conveyed

A weighing scale that automatically weighs loads while being lifted or conveyed by a crane or hoist has been developed by the Kron Co., Bridgeport, Conn., manufacturer of industrial weighing scales. The scale, which is placed in the lifting line, indicates the weight of the load on a large dial as soon as the load has been lifted clear of its support, and continues to do so until the load has been deposited at its destination. Thus it is possible to read the weight at any point during the journey. These scales are made in two types—one for ordinary use, and the other for use where head room is limited. They are made in capacities varying from 750 to 50,000 pounds.

Expanding Gage for Measuring Bearing Bores

An expanding gage for use in measuring the bearing bores of aircraft engines during boring or reaming operations is shown in the accompanying illustation. This gage was described by H. C. Downey, Mitchell Field, N. Y., in a paper presented before a meeting of the American Society of Mechanical Engineers. The device is inserted in the bearing and allowed to expand. An outside micrometer can then be used as shown to take the measurement or the measurement can be read directly from graduations on the gage itself.



Method of Measuring Bearings by the Aid of Expanding Gage

The expanding device has two outside blocks with cylindrical surfaces machined to the proper size for the bearings to be gaged. Between these outside blocks is a sliding V-block, operated by a knurled-head screw with graduations on the head. Obviously this gage is more rugged than the type of inside micrometer generally employed for inside measurements. It cannot become cocked in the bearing and takes only the minimum or high-spot measurement.

* * *

Crowning Pulleys in a Drill Press

By AVERY E. GRANVILLE

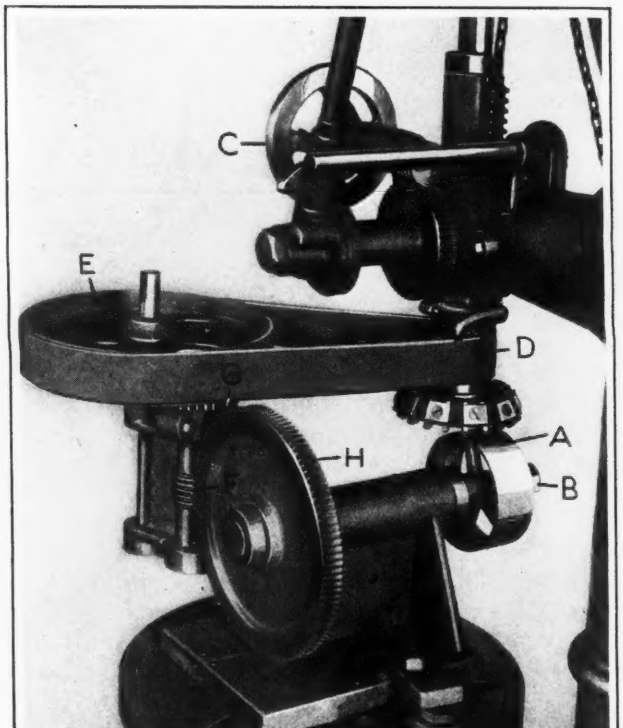
Not long ago a certain job shop received an order to build several hundred small machines. Each of these machines required five cast-iron pulleys, 6 inches in diameter, with crowned faces 1 1/2 inches wide. As no lathes were available for the crowning operation, an upright drilling machine was arranged to handle this work.

A simple crowning device was built, as shown in the illustration. It will be seen that this device is clamped to the table of the machine, and the pulley to be crowned placed on the work-spindle, as shown at *A*. A nut *B* on the outer end of this spindle locks the pulley securely in place. An 8-inch diameter milling cutter, fastened to the machine spindle, is then lowered into the cutting position by turning the handwheel *C*, which operates the worm feed of the machine.

As the spindle of the drill press rotates, a small pulley *D* on the lower end of the machine spindle, just above the milling cutter, revolves the large pulley *E*. This pulley, in turn, rotates the worm *F* through a train of reduction gears *G*. The worm drives the worm-gear *H* on one end of the work-spindle, and thus the pulley to be crowned is given a rotary feeding movement. It is obvious that once the milling cut is started, the finishing of the pulley is automatic.

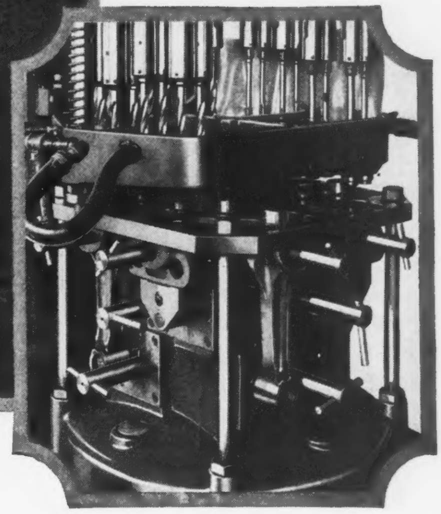
The production obtained by this method enabled the shop to keep well ahead of the rest of the job, and the crowning was good enough for the purpose.

The amount of crown can be varied by moving the work-spindle horizontally to or from the center of the milling cutter. One advantage of the design described is that by moving the pulley *E* upward on its shaft, pulleys of much larger diameter than shown may be crowned. It may be necessary, however, to use a larger pulley *E* in order to obtain the correct feeding movement of the work-spindle.



Crowning a Pulley with a Milling Cutter in a Drill Press

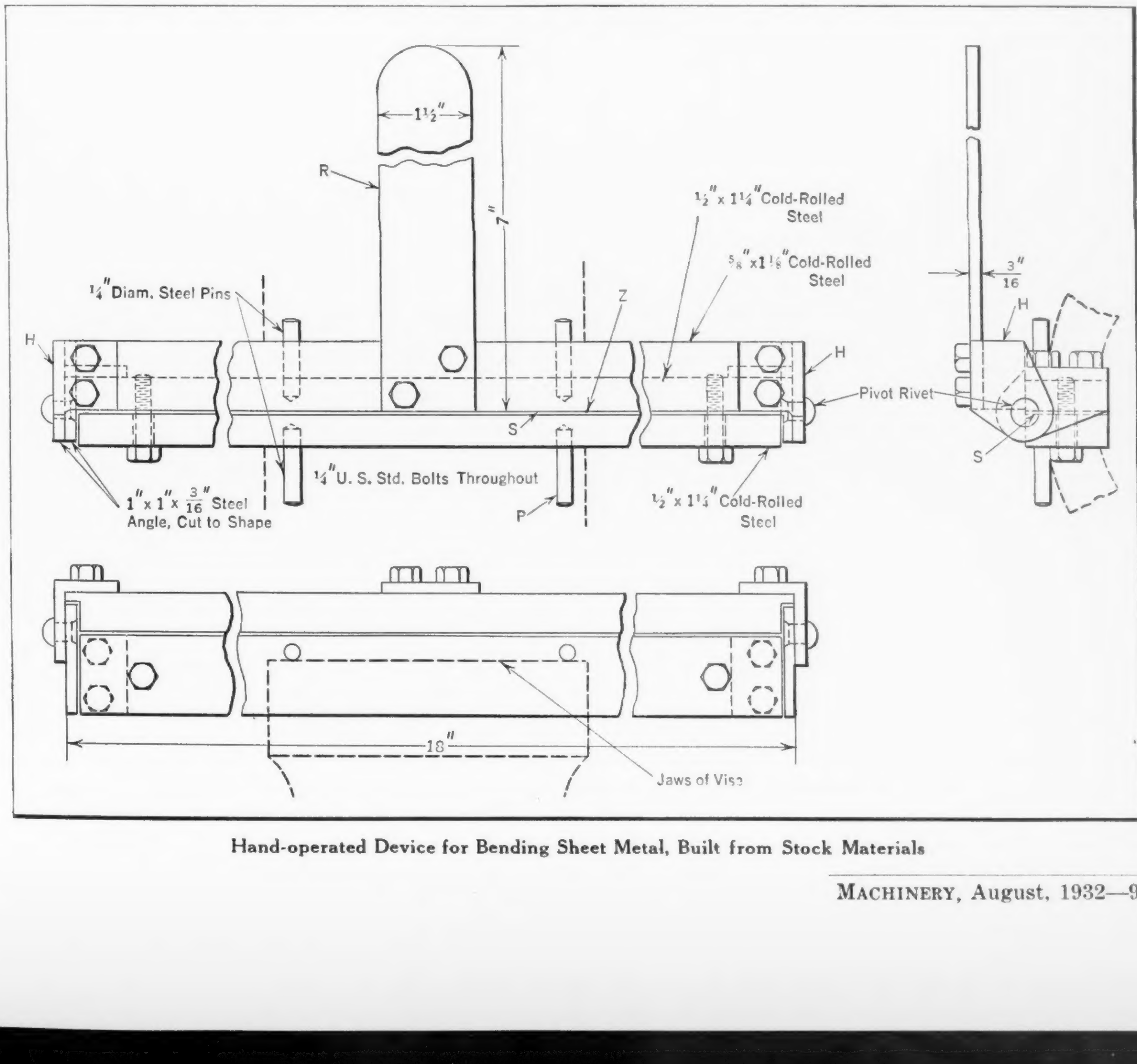
Design of Tools and Fixtures



Simple Sheet-Metal Bending Device for Small Shops

By WALTER E. STEWART, Sewaren, N. J.

Many small shops have considerable work that could be handled advantageously on a sheet-metal bending machine, but the demands are not sufficient to warrant the purchase of even a small machine of this type. The simple device shown in the accompanying illustration can be built easily from stock materials. It costs very little and gives results that compare favorably with the work produced on commercial machines costing much more. A device of this type has been in operation for more than a year on work that regularly consists of bending material up to 1/8 inch thick by 15 inches wide. Bends can be made to any angle up to 90 degrees.



Hand-operated Device for Bending Sheet Metal, Built from Stock Materials

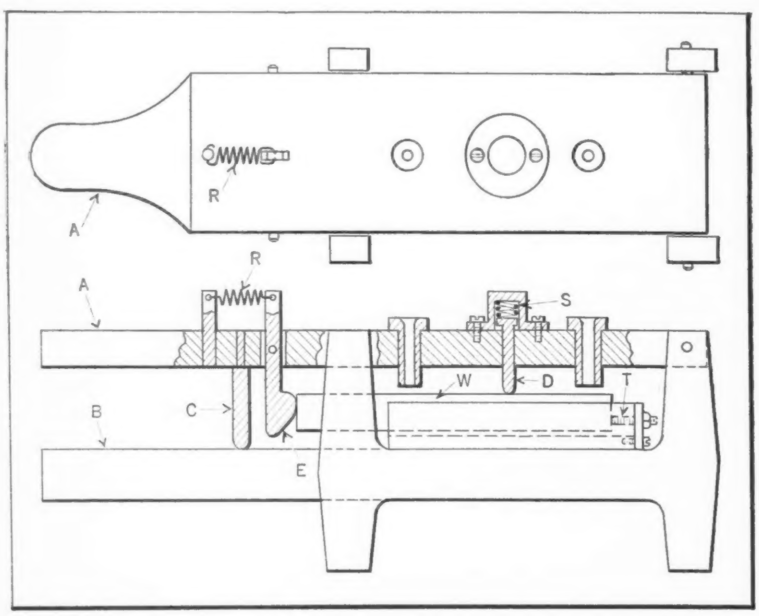
In constructing the bending device shown, it is preferable to use cold-rolled steel, as the accurate edges and smooth surfaces of this material are an important advantage. The four pins *P* serve to support the device in an ordinary bench vise. Two through bolts hold the forward clamping piece loosely in place. These bolts are a clearance fit in the holes in the forward clamp and are screwed into tapped holes in the rear clamp. The hinges *H* are made from ordinary angle steel, which is sawed and filed to the required shape. Rivets are made to serve as pivots for the hinge members. A machine of the dimensions shown is used in a small shop where many experimental devices are made up. The dimensions could, of course, be changed to suit special requirements.

The bending device rests loosely in the jaws of a bench vise, when ready for use. The sheet to be bent is inserted in the space *S* between the two clamping pieces. The vise jaws are then tightened, pressing the front clamp inward and causing it to slide freely along its supporting bolts and clamp the sheet metal in place. The handle *R* of the hinged bar is then pulled over until the sheet metal is bent to the desired angle.

Drill Jig with Work-Locating Clamp

By C. KUGLER, Philadelphia, Pa.

A drill jig having no clamping screws or cams for the operator to forget to tighten is shown in the accompanying illustration. This type of jig has proved so successful in a large radio plant where girls and women are employed that it is used for drilling small pieces whenever possible. All parts of the jig are made from cast iron, including the lid in which the drill bushings are located.



Jig with Spring-actuated Locating and Clamping Members on Hinged Leaf

When the jig is in use, the operator inserts the work and holds the jig with one hand by grasping the handles *A* and *B*. This closes the lid, bringing stop *C* into contact with handle *B*. The work *W* is located in a V-block and held in place by plunger *D*, which is under the tension of spring *S*. The work is pushed against the stop *T* by a lever *E* actuated by the spring *R*. In this case, the work is a piece of fiber in which two holes are drilled.

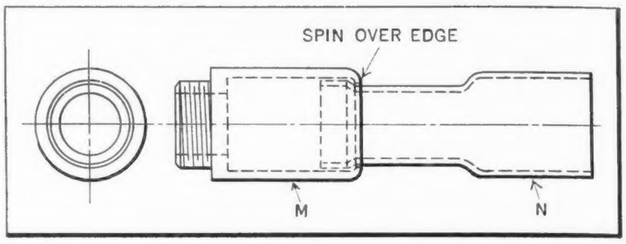


Fig. 1. Method of Assembling Part N Formed on Die Shown in Fig. 2

Forming Die for Seamless Steel Tubing

By F. J. SANDERS, Dayton, Ohio

The flexible tube fitting shown in Fig. 1 consists of two pieces *M* and *N*, held together by spinning the end of one piece over a shoulder on the other. Part *N* is formed from a straight piece of seamless steel tubing on the punch press die shown in Fig. 2, after being cut off on an automatic screw machine. The blanks are cut off 1/32 inch shorter than the finished length of the part to allow for stretching.

The die consists of two hinged blocks *A* and *B*, each of which contains one-half the cavity into which the tubing is forced. After the part *N* is formed, the half of the die at *A* can be swung to the left to allow the part to be removed. The views show the die in nearly the closed position.

Both members of the die are mounted on a plate *D*; this plate, in turn, rests on pins *E* which receive pressure from a rubber pressure-pad or spring on the punch press. This pressure strips the part off punch *F* after the short shouldered end is formed.

Blocks *J* serve two purposes: First, to stop the travel of the pad at the end of its upward stroke, and second, to prevent the two halves of the die from spreading apart at the bottom while the part is being forced through them. The block *C* also holds the die together at the top.

The hardened punch *H* is the same diameter as the tubing to be formed, and takes the thrust developed in pushing the part through the die. A sliding bushing *G* drops around the outside of the part and prevents it from becoming distorted.

In operation, the blank is placed in an upright position in the die, the bottom of the blank resting on the 20-degree taper in the hole and the top ex-

tending a short distance above the die. When the ram descends, bushing *G* slips over the blank and punch *H* pushes the blank through the narrow part of the die.

The spring pressure holding the die up is greater than the force required to push the blank through the die; therefore, the die does not start to move downward until the end of the blank is flush with the top of the die and block *C* engages the top of the die. As the die moves downward, punch *F* completes the forming of the end of the blank.

To complete the assembling operation of the part shown in Fig. 1, part *M* is held in a collet in a lathe and the end of part *N* inserted. The end of part *M* is then spun in place with a roller tool held in the toolpost of the lathe. To facilitate this operation, the end of part *M* is beveled before being assembled.

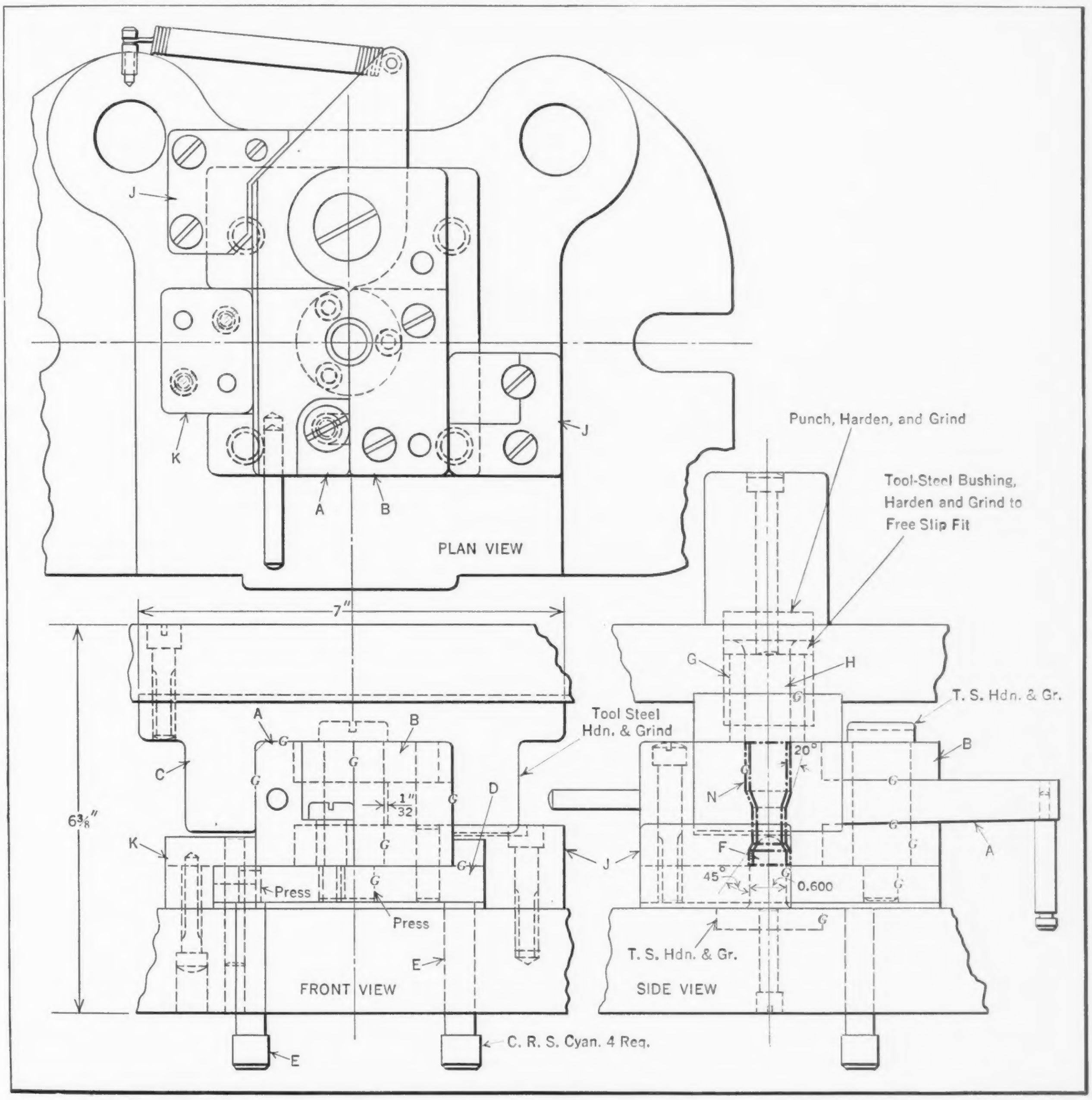


Fig. 2. Die for Forming Part N, Fig. 1, from Seamless Steel Tubing

Quick-Acting Fixture for Detecting Leaks in Cylinder Heads

By D. L. BROWN, Summit, N. J.

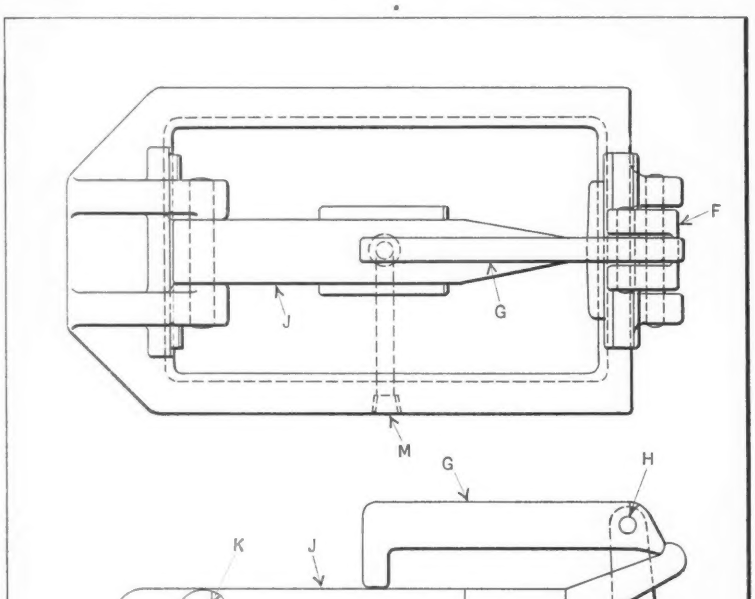
Cylinder heads are tested at the foundry of one plant before machining in order to locate any leaks resulting from porosity or casting defects. In this test, all openings in the casting are closed by means of the fixture illustrated (see next page). The fixture, with the head, is then submerged in water, and compressed air is let into the head. Any leaks are quickly detected by bubbles formed by the escaping air at the defective points.

Air pressure is preferred for testing rather than water pressure, because the operation can be performed much more quickly in that way, and air leaks through very fine cracks or holes are easy to

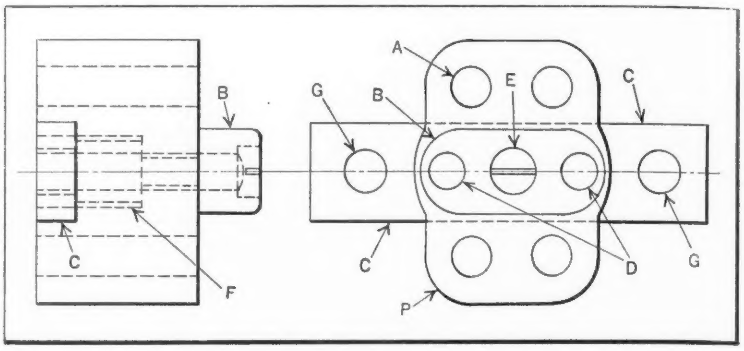
detect. However, water pressure can be used in the same fixture, but the operator must be cautioned not to allow air to become pocketed in the casting; otherwise the test may be deceptive.

In the aluminum base *A* is a thick rubber pad *B* upon which the cylinder head casting is placed. The rubber used is spongy enough to form a tight seal, regardless of the rough surface of the casting. Two additional rubber pads *C* and *D* are held in place by the cages *E*. These pads are provided to seal the hose outlets of the head. The pad *D* is mounted on the lever *F* which is pivoted to the base. This lever is equipped with a cam-handle *G*, pivoted at *H*, which clamps all three pads against their respective openings simultaneously. The cam-handle *G* is designed to apply the required pressure to each of the rubber pads. Lever *J*, pivoted at *K*, carries the clamping block *L*.

As shown, the fixture is loaded and ready for the test. The air-supply line is attached to the inlet *M* in the base, through which the air is conducted to the cylinder head. To unload the fixture, cam-handle *G* is raised and swung back, releasing lever *J* so that it can be swung back out of the way.



Fixture for Testing Cylinder Heads for Leaks, in which One Lever Closes all Openings in the Casting Simultaneously



Punch of Simplified Design for Use on Compound Die

Form-Blanking Punch of Simplified Design

By EUGENE L. SOLTNER, Philadelphia, Pa.

It is sometimes desirable or more economical to make a blanking punch the same form throughout its length than it is to make the punch with an enlarged base. Small punches made in this manner generally require some provision for maintaining alignment, such as the plate *C* shown in the accompanying illustration. The punch *P*, in the case illustrated, is the same shape throughout its length. It is part of a compound die, and has four piercing holes *A*. The pilot *B* is secured to the punch by the screw *E*. The rectangular plate *C* has two holes *G* for dowels which serve to locate the die on the bolster. The two dowel-pins *D* align the pilot and the plate *C* on the punch. At *F* is a large tapped hole for securing the punch to the bolster.

Inexpensive Three-Position Transfer Die

By JOHN E. ORBAN, Philadelphia, Pa.

A limited number of parts such as shown in the view to the right in Fig. 1 were required to be made from sheet aluminum 0.032 inch thick. The problem was to design an inexpensive press tool that would produce the parts somewhat faster than they could be made by hand. The die made for this purpose is shown in Fig. 2. It proved very satisfactory, giving a production rate of 1000 pieces per hour. Three blows of the press ram are required to complete one piece, but only one handling of each piece is necessary.

In operation, a blank, which has been sheared to size, is placed between the stop-pins *A* on the face of the die and between the locating pins *B* on the transfer or shifting rod *C*, the latter rod being pulled forward so that the blank is lo-

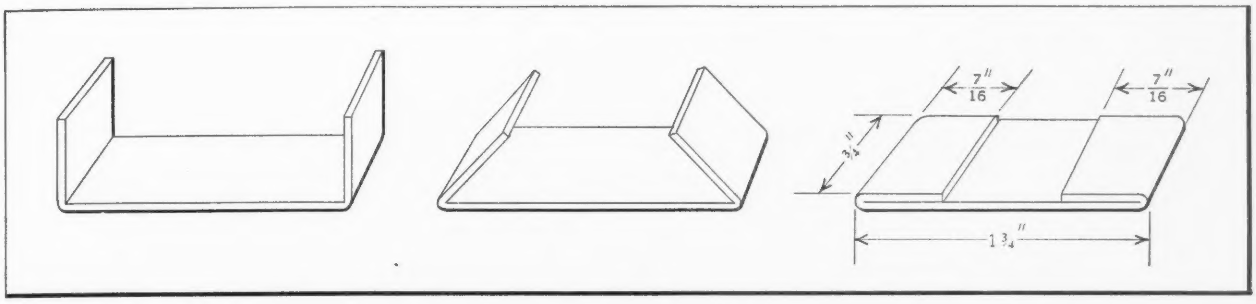


Fig. 1. Three Steps in Forming Aluminum Part in Die Shown in Fig. 2

cated under the first section *D* of the punch. One stroke of the press then forms the blank into a U-shape, as illustrated in the view to the left in Fig. 1.

The shifting rod is next pushed back until the piece is under the second section *E* of the punch. The second stroke of the press now bends the ends over, as indicated in the central view, Fig. 1. Then the shifting rod is again pushed back until the piece is under the third section *F* of the punch, where the bent-over ends are pressed down to complete the work. The finished piece is ejected from the die by pushing the shifting rod back until the work clears the die and falls off the shifting rod. The location of the piece in the three positions is accomplished by means of a spring-backed indexing pin *G* and spots drilled in the under side of the shifting rod.

The punch of this die is made up of three sections of cold-rolled steel fastened to a holder. The first and third sections are alike, except for length. The square slot milled through all three sections provides clearance for the locating pins in the shifting rod. The second section *E* of the punch has a V-shaped face. The die member is simply a piece of cold-rolled steel with a channel milled across the face and a hole drilled and reamed to receive the shifting rod. A slot is cut across the die to provide clearance for the locating pins. The tendency of the parts to adhere to the first section of the punch was completely overcome by an occasional application of oil to the milled channel of the die.

* * *

In an effort to increase traffic, the steam railroads are studying the practicability of constructing "stream-line" rail motor cars designed to bring about faster service with greater economy in operation. The use of rubber-tired wheels on railway cars is also being considered.

Electric Eye Weighs Moving Material on Conveyor Belt

The electric eye, in conjunction with other equipment, has now been developed to a point where it will weigh and record the steady flow of material on a moving conveyor belt. While in this scheme the general method of weighing a continuous flow of material is the same as usual, the method of converting the passing weights into corresponding electrical impulses for operating the integrator has been radically changed by the introduction of the photo-electric cell. This ingenious development is the work of the engineering staff of the Burgess Battery Co. and of John Chatillon & Sons, New York City.

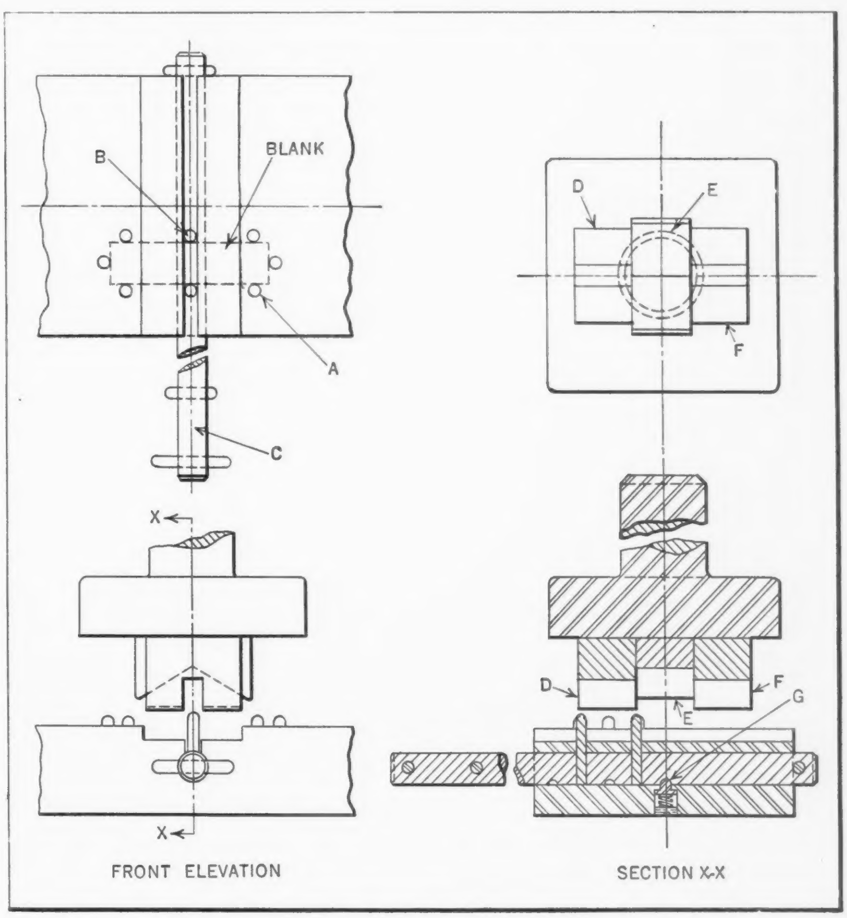
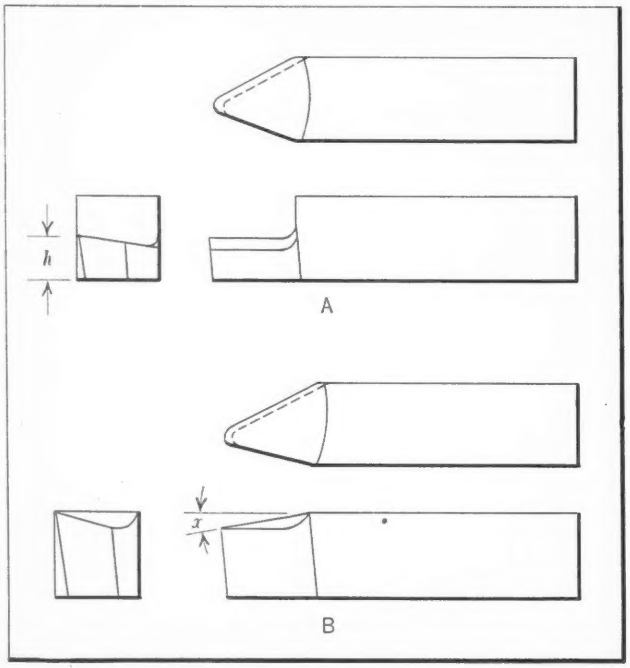


Fig. 2. Three-position Transfer Die for Bending over Both Ends of Flat Aluminum Piece, as Shown at the Right in Fig. 1

Conserving Cutting Tools and Bits

By WILLIAM C. BETZ, Master Mechanic
Fafnir Bearing Co., New Britain, Conn.

In looking over a large quantity of tool bits recently, the writer found that almost all of them were ground as shown at *A* in the accompanying illustration. These cutters had been ground by many different men in various departments, indicating that the majority of the workmen did not know how to grind tools and cutter bits to get the most out of them. By grinding the tools on top instead of on the end and top, as shown at *B*, the height was reduced as shown at *h*.



(A) Incorrectly Ground Tool; (B) Correctly Ground Tool

After grinding a tool several times on the top surface, the height *h* is cut down and the tool becomes too frail for a heavy cut, so that it is necessary to grind the remainder of the ledge away and regrind the end to shape. Each time this is done, about 25 per cent of the life of the tool is sacrificed. In addition, there is the time lost in grinding the ledge away and re-forming the end.

If the tools or bits are ground so that the top rake from the point is at a slight angle x with the top, as shown at *B*, and the tool is ground on the end and top at this angle each time, it will never develop a ledge and will have exactly the same shape and angle when it is ready to be scrapped as it did when new. By grinding the tools as at *B*, at least 25 per cent of the cutting metal is saved, besides the time required in cutting away the ledge and re-forming the cutting end.

Faceplate Boring in a Milling Machine

By CHARLES C. TOMNEY, Chief Tool Designer
Brunswick-Kroeschell Co., New Brunswick, N. J.

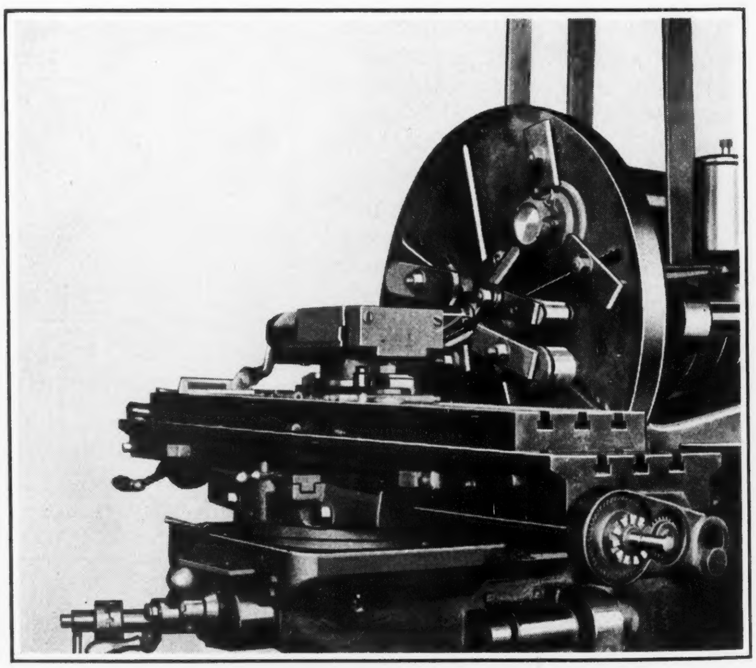
To avoid interrupting regular production, one plant employs a milling machine for doing odd boring jobs ordinarily performed in a lathe equipped with a large faceplate. As indicated in the illustration, the milling machine spindle is equipped with a faceplate, the diameter of which is 30 inches. The part set up on this plate is a connecting-rod which is to be rebored. The work is located and clamped to the faceplate in the usual way.

To provide a means for holding the boring tool, a milling vise is clamped to the machine table and the tool is held in the jaws at the correct height. The operator uses the traverse hand-feed for adjusting the tool to the required diameter. After clamping the table in position, the lateral feed is engaged and the hole is bored to the required size just as readily as in a lathe.

The diameter of the faceplate is limited only by the height of the knee. However, by blocking up the vise, the knee can be lowered and a larger faceplate used.

* * *

Some unusual failures of split pulleys are referred to in *The Locomotive*. If pulleys are unusually wide and the rim is supported only by spokes in the center, the centrifugal force, when the pulleys are running at high speed, has a tendency to bend the outer edges of the rim outward at the point where the two halves of the pulley are joined. Cracks in wide pulley rims have been found in several cases; this explanation seems to indicate the most plausible cause.



Milling Machine Equipped with Lathe Faceplate for Doing Odd Boring Jobs in the Tool-room

PORTABLE DRILLS WITH JACOBS TAPERS OR THREADS FOR CHUCKS—1

Model Number of Portable Drill	Chuck Size, Inch	Taper No. or Thread Size, Inch
Albertson & Co., Inc., Sioux City, Iowa	*(Sioux)*	
1490	1/4	3/8
1500, 1525	1/4	1/2
1540	5/16	1/2
1545, 1550	1/2	5/8
1560	5/8	5/8
1575	3/4	3/4
Black & Decker Mfg. Co., Towson, Md.	*(B and D)*	
....	3/16	3/8
KLM	1/4	No. 1
A	1/4	No. 2
B	5/16	No. D
C and above	5/16	No. 2
To and including F	3/8	No. D
G	3/8	No. 2
C Special	1/2	No. 6
BB, to and including K	1/2	No. E
To and including M	5/8	No. E
P, PG	5/8	No. 3
A, B	3/4	No. 3
Buckeye Portable Tool Co., Dayton, Ohio	*(Hercules)*	
15, 113	1/4	3/8
00-3, 16	5/16	3/8
0-3, 0-5, 01-3, 01-5	1/2	5/8
206-3, 206-5	5/8	45/64
Chicago Pneumatic Tool Co., New York City	*(Little Giant)*	
000B, 000	3/16	No. 1
000XB, 000X	1/4	No. 2
00B	5/16	No. 2
1B	3/8	45/64
25-26B, 25-26C-F	5/16	1/2
25-26D	3/8	1/2

Model Number of Portable Drill	Chuck Size, Inch	Taper No. or Thread Size, Inch
Chicago Pneumatic Tool Co.	(Continued)	
37A	3/8	45/64
37C, 37E	1/2	45/64
1 1/2B, 37F, 37H	5/8	45/64
(Hicycle)		
12 Series	3/16	3/8
00A, 00C	5/16	3/8
20 Series	5/16	1/2
0E, 0F, 0G, 30-1640, 30-1200, 30-1215	3/8	1/2
5A, 5C, 5E, 40-770, 40-1025	1/2	45/64
30-860	1/2	1/2
40-610, 40-290	5/8	45/64
(Pneumatic)		
10A	1/4	45/64
10B-C	3/8	45/64
10D, 3B, RB	1/2	45/64
3C, RC	5/8	45/64
Cincinnati Electrical Tool Co., Cincinnati, Ohio	*(Cincinnati)*	
ULS, UAS	1/4	3/8
UBS	5/16	1/2
UK	3/8	1/2
UT	3/8	5/8
UO, UH	1/2	5/8
UE, UED	5/8	5/8
UW	3/4	3/4
Jas. Clark, Jr., Electric Co., Inc., Louisville, Ky.	*(Clark)*	
No. 1 Pegging	1/8	No. 1
No. 2 Pegging, 00-UA	3/16	No. 1
0-UA, 0-U, 0-AG, 000U	1/4	No. 1
1/2-UA	5/16	No. 2
1-U, 1-AG, 1	3/8	No. 2
2-AG	1/2	No. 6
2, 3, 2-U, 3-U	5/8	No. 6
1HT, 2HT	3/4	No. 3

MACHINERY'S Data Sheet No. 231, New Series, August, 1932

Contributed by Jacobs Mfg. Co., Hartford, Conn.

PORTABLE DRILLS WITH JACOBS TAPERS OR THREADS FOR CHUCKS—2

Model Number of Portable Drill	Chuck Size, Inch	Taper No. or Thread Size, Inch
Cleveland Pneumatic Tool Co., Cleveland, Ohio	*(Cleco)*	
1B, 1BB, 1BF	1/4	3/8
66H, 66RH, 66L, 66RL, 1-NH, 1-NL	3/8	45/64
1-NC, 1-RC	3/4	45/64
Dumore Co., Racine, Wis.	*(Dumore)*	
2-AD	1/8	No. 0
2-BD (Discontinued)	1/4	No. 1
Gilfillan Bros., Inc., Los Angeles, Calif.	*(Gilfillan)*	
....	1/4	3/8
....	1/2	45/64
....	5/8	45/64
Hisey-Wolf Machine Co., Cincinnati, Ohio	*(Hisey)*	
15, 18	1/4	No. 2
25	5/16	No. 2
35	3/8	No. 2
45, 50	1/2	No. 6
58	5/8	No. 3
75	3/4	No. 3
Independent Pneumatic Tool Co., Chicago, Ill.	*(Thor)*	
UKB, UKC, UKCC, UKD, UKO, UKT, UAA, UAC, AKC, AKCC, AKA, ULB, ULD, ALB, ALC	1/4	3/8
UAB, UAD, UAS, AKB, AKD	5/16	3/8
UCA, UCB, AAA, AAB, AAC, AAD	5/16	1/2
UBA, UBB, UBC, UBD, UBL, UBS, UCE, ABA	3/8	5/8

Model Number of Portable Drill	Chuck Size, Inch	Taper No. or Thread Size, Inch
Independent Pneumatic Tool Co., Chicago, Ill.	(Continued)	
ABB, ABC, ABD	3/8	5/8
AKE, AKF	3/8	1/2
UHB, UCL, UDA, UDS, UDN, ABH, ABN, ABO, ABS, AACA, AACB	1/2	5/8
UDB, UDP	9/16	5/8
UCN, UEN, AACC, AACS, ADA, ADB	5/8	5/8
(Pigmy)		
25	1/4	3/8
375, 375L	3/8	5/8
50	1/2	5/8
Ingersoll-Rand Co., New York City	*(Ingersoll-Rand)*	
1H	3/16	3/8
1L	5/16	3/8
6,600	3/8	45/64
D, DD	9/16	45/64
6E, 600E	5/8	45/64
Jones Motrola Sales Co., New York City	*(Jones)*	
....	1/4	No. 1
....	3/8	No. 2
William H. Keller, Inc., Grand Haven, Mich.	*(Super Pneumatic Tools)*	
000	1/4	No. 1
00	3/16	No. 1
0, 0R	3/8	45/64
0S-1, 0RS-1, 1VH, 1VHR	7/16	45/64
0S-2, 0RS-2, 1V, 1VR	1/2	45/64
0S-3, 0RS-3, 1VS-1, 1VSR-1	5/8	45/64

MACHINERY'S Data Sheet No. 232, New Series, August, 1932

Contributed by Jacobs Mfg. Co., Hartford, Conn.

Denitriding in Salt Baths and Molten Aluminum

The Field for Nitriding has been Greatly Broadened by the New Processes for Local or Entire Softening of the Nitrided Case

By H. H. ASHDOWN, Metallurgist
Westinghouse Electric & Mfg. Co
East Pittsburgh, Pa.

THE importance of the nitriding process in cases where very hard wearing surfaces and resistance to abrasion and atmospheric corrosion are essential is generally recognized. This process has been described in previous articles in MACHINERY. However, not so much is known of the methods used for "denitriding" or softening the nitrided case. Ordinary annealing is impractical for this purpose, as even the relatively high annealing temperatures do not soften the case sufficiently for machining.

Many occasions arise when it is desirable or necessary to soften the whole or certain portions of nitrided parts. For example, nitrided die-casting dies, which are costly tools, are designed for mass output; and during production, die alterations may be required owing to changes in the design of the product. Unless adequate means are available for softening the case, the change in design would mean added expense for a new die, instead of the relatively low cost of a slight alteration on the old one.

Action of Denitriding on the Case

Although the term "denitriding" is used to denote softening of the nitrided case, this expression is a misnomer. Observations led the author to believe that high-temperature treatments of the nitrided case, either in a furnace or by means of salt baths, do not denitride the steel. On the contrary, the nitride needles still remain in the grain boundaries of the case; but at elevated temperatures a change in the state of the nitrogen combination may take place, resulting in a partial diffusion of the nitrides. By slow cooling from these elevated temperatures, a softening of the case results.

One of the first metallurgists to publish the results of his research in softening the nitrided case—W. J. Merten—found that by immersing nitrided parts in a bath of fused sodium potassium nitrate, the case was softened so that it could be readily machined. For instance, when a nitrided case having a hardness of 1000 Vickers Brinell was heated in a salt bath to 800 degrees C. and slowly cooled, it was softened to 380 Vickers Brinell.

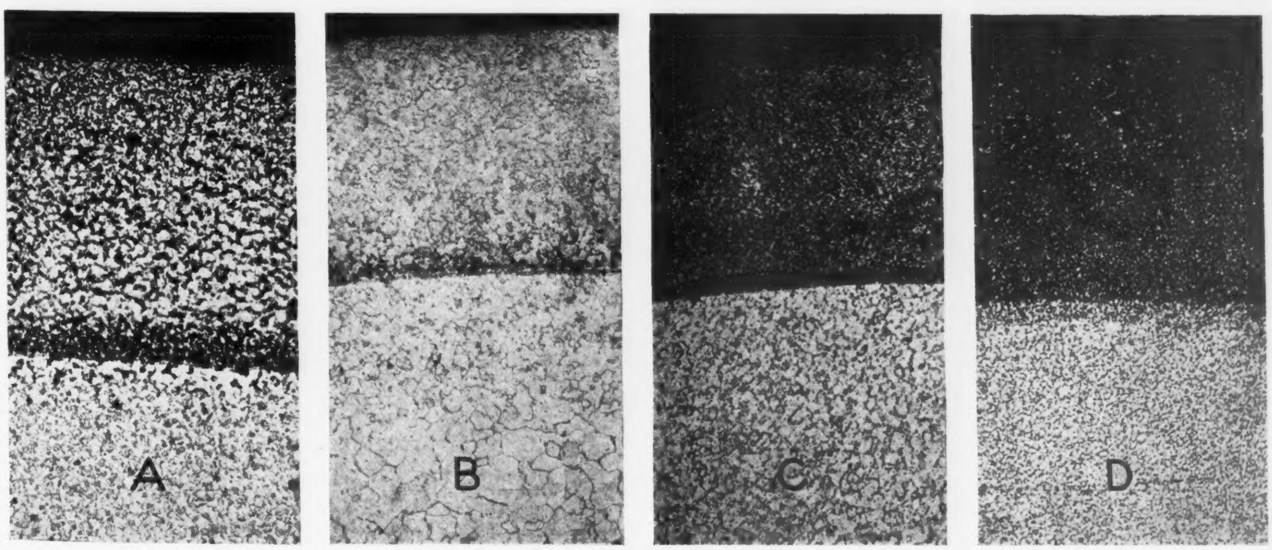
It is known that surface decarburization takes place when tool steels are heated in a salt bath. This decarburization also takes place on the nitrided case. There is, however, a dual advantage here, as the temperature and period of decarburization are the same as for the inward diffusion of the nitrides. Thus, both decarburization and the inward diffusion of the nitrides result in the maximum softness.

The Use of Powdered and Molten Aluminum in Softening the Case

It has been found that by heating nitrided parts in aluminum powder up to the melting point of the powder (660 degrees C.), the aluminum fuses readily with the nitrided case, which then becomes comparatively easy to machine. By immersing nitrided parts in a molten bath of aluminum for a short period—a matter of minutes—the entire case may be fused away.

This method of softening or quickly removing the case may not at first appear to be applicable for commercial use on account of the cost of the alu-

Fig. 1. Photomicrographs of the Denitrided Case of Four Different Specimens, Magnified 100 Times, Showing the Diffusion of the Nitrides and the Decarburization that Result in Softening of the Case



minum; but commercial aluminum is comparatively inexpensive. Furthermore, after continuous use for this purpose, it can be employed as a deoxidizer for the steel bath. When a major alteration to a tool is necessary, the entire tool has to be softened, and the softened surface must be removed to at least the full depth of the original case. If this is not done, the new nitrided case may spall badly.

Local Denitriding with Molten Aluminum

To avoid distortion or cracking, when minor alterations on large tools are required, the entire tool should be carefully heated to from 400 to 500 degrees C., at which temperature the nitrided case is unaffected. The surfaces of the tool that do not require to be machined are protected by a shield and molten aluminum is poured over the portions to be softened, after which the tool is buried in lime or sand until it can be handled. The portions over which the aluminum has been poured will then be comparatively easy to machine. After being machined, the entire tool should be renitrided.

Spot softening can also be readily effected by the skilful use of the torch. A ring of compressed lime or asbestos is surrounded with non-conducting material to protect the adjoining nitrided surface and the area within softened by heating with a torch. With this method, an area as small as 3/8 inch in diameter can be softened for drilling without materially affecting the surrounding nitrided case, thus obviating renitriding. This is of considerable importance when it is necessary to drill and relocate core-pins in die-casting dies or to cut small channels in these or similar nitrided tools.

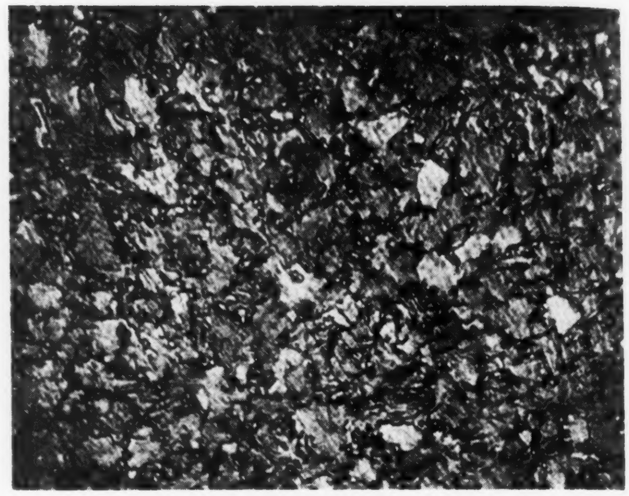


Fig. 3. Specimen Magnified 1000 Times, Heated in Aluminum Powder Fifteen Minutes, but Showing Little Decarburization or Diffusion of the Nitrides

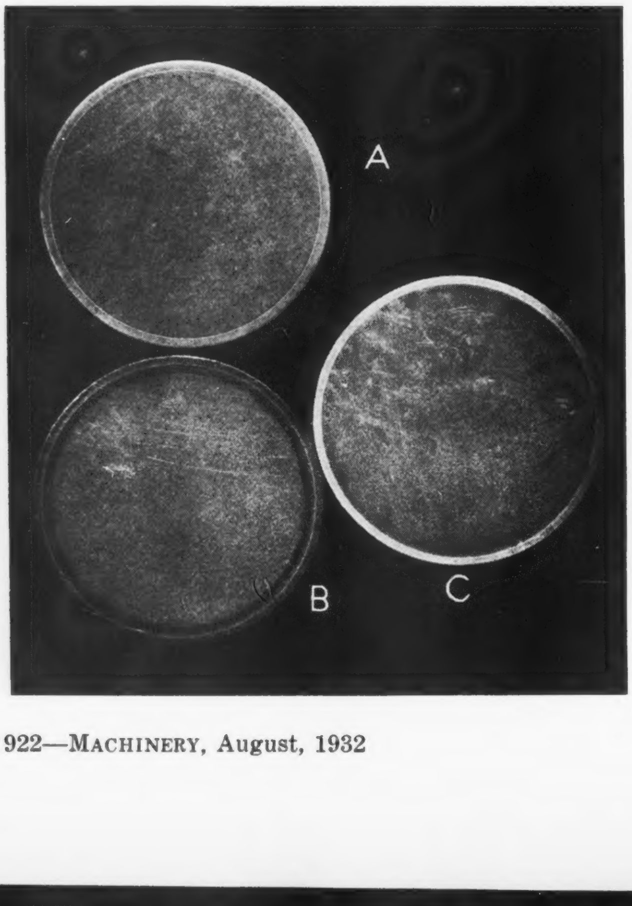


Fig. 2. Transverse Sections of Three of the Denitrided Specimens Illustrated in Fig. 1. Specimen B, which was Softened in a Salt Bath, Shows Clearly Diffusion of the Nitrides

Relieving the brittleness in pointed or thin sections that may have been over-nitrided can be done by encasing the portions required to retain their maximum hardness in a suitable non-conducting material and then exposing the over-nitrided areas for a short period in a non-oxidizing atmosphere having a temperature of 700 degrees C.

Experiments Proving that the Inward Diffusion of the Nitrides and Decarburization Soften the Case

Experiments have been conducted which show that the major fall in Brinell hardness of the nitrided case results mostly from an inward diffusion of the nitrides. All the specimens were selected at random from a supply of heat-treated nitriding steel of the following composition: Carbon, 0.27 per cent; silicon, 0.20 per cent; manganese, 0.55 per cent; molybdenum, 0.80 per cent; and aluminum, 1.20 per cent. The specimens were nitrided under identical conditions in a container, together with a load of miscellaneous parts weighing about 1750 pounds.

Four nitrided specimens were lettered and treated as follows:

Specimen A—Heated for one hour at 800 degrees C. in an electric furnace and buried in lime to cool. Vickers Brinell hardness as nitrided was 925, and after the treatment, 430.

Specimen B—Heated for one hour at 800 degrees C. in a sodium potassium nitrate bath ($NaNO_3$ + KNO_3) and buried in lime to cool. Vickers Brinell hardness as nitrided was 925, and after the treatment, 389.

Specimen C—Heated for one hour at 800 degrees C. in potassium cyanide bath and buried in lime to cool. Vickers Brinell hardness as nitrided was 944, and after the treatment, 442.

Specimen D—Heated for one hour at 660 degrees C. in aluminum powder, resulting in a partial fusion of aluminum with the nitrided case. Vickers Brinell hardness as nitrided was 937, and after the treatment, 420.

Photomicrographs of the cases of these four specimens after these heat-treatments are shown in Fig. 1. It will be noted that in Specimen *A* partial decarburization of the case has taken place, with little nitride diffusion beyond the darkened band. Specimen *B* shows almost total decarburization of the case, together with inward diffusion of the nitrides. Unlike the action in Specimen *A*, the penetration of the nitrides inward has been more rapid and is well beyond the line of demarcation. This accounts for the narrowness of the darkened band. It should further be observed that partial decarburization has taken place to some depth beyond the nitrided case. As less satisfactory results are obtained when nitriding low-carbon steels, nitrided parts softened by this process should receive a liberal machining allowance in order to expose the parent metal before renitriding.

Considerable carburization and comparatively little dispersion of the nitrides is shown in the case of Specimen *C*. Despite this, the relative fall in hardness is marked. This would seem to show that the softening of the case is due more to the partial inward diffusion of the nitrides and change in their constitution than to decarburization. It would also indicate that the nitrides are more strongly held by the presence of increased carbon.

It might be stated here that the Vickers Brinell hardness of the parent metal before nitriding is approximately 230, and the greatest softening obtained after nitriding has resulted in a hardness of about 350. This is probably due to a solid solution of those nitrides of a more stable character.

The object of heating the specimen in aluminum powder, as was done with Specimen *D*, was to soften the case by an outward absorption of the nitrides. It appears, however, that the effect of the aluminum up to its melting point is to retard the inward diffusion of the nitrides without any absorption.

Fig. 2 gives a clearer idea of the decarburization of the nitrided case. The specimen letters correspond with those in Fig. 1. This shows transverse sections of the specimens. In the case of Specimen *B*, which was softened in a salt bath, the inward diffusion of the nitrides can better be observed.

In Fig. 3 is shown a specimen that was heated in aluminum powder up to the fusing point of the aluminum and held at this temperature for fifteen minutes. At a magnification of 1000 it is seen that little, if any, decarburization has taken place and that there has been little diffusion of the nitrides.

The Die-Casting of Aluminum Alloys Has No Softening Effect on Nitrided Dies

From what has already been said regarding the effect of aluminum on the nitrided case, it may be thought that it would be of little value to apply the nitriding process to dies for aluminum die-castings. It should be remembered, however, that die-casting dies dissipate the heat rapidly. Their faces are air-cooled and the molten aluminum under these conditions solidifies rapidly. Nitrided die-casting dies used in the Westinghouse plant for aluminum parts have given exceptionally long service. Nitrided surfaces are little affected by heat below a temperature of 650 degrees C., but at 700 degrees C. a marked fall in the hardness takes place. This is caused by the inward diffusion of the nitrides. With each increment of heat up to 800 degrees C., softening of the case continues.

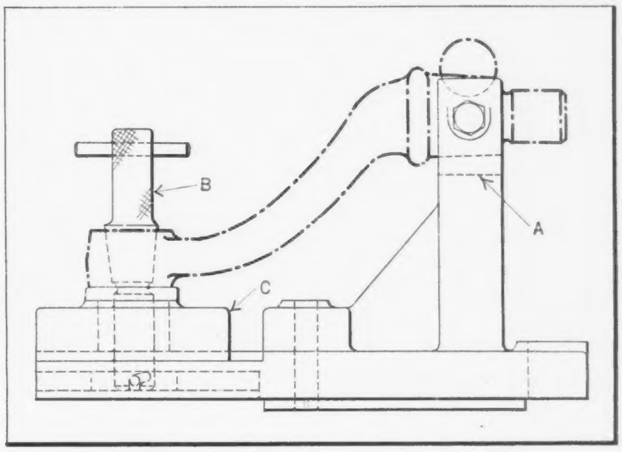
* * *

Milling Keyway in Tapered Offset Arm

By URVING G. THOMAS, General Superintendent
Eclipse Counterbore Co., Detroit, Mich.

Referring to the article entitled "Milling Keyway in Tapered Offset Arm" in January MACHINERY, page 355, the writer would suggest an improvement that would adapt the fixture for use on quantity production work of high quality. The only flexible part of the fixture, as originally shown, is at the tapered bearing. This is not a good feature, as the taper should always be located centrally, so that the keyway will be exactly in the center. The flexible part of the fixture should be at the tapered hole in the arm.

In the suggested design shown, these requirements are met. The arm is centered accurately in the tapered bore of the hardened bushing *A*. This bushing is slotted at the top to permit the cutter to enter the work. Tapered plug *B*, which is provided with a bayonet lock, is then passed down through the other end of the arm, locking it securely to the sliding block *C*. In this way, any variation in the length of the arm will be compensated for by the sliding block. This method of compensating for variations in the work does not affect the location of the slot milled in the tapered bearing.



Suggested Design of Fixture for Obtaining Greater Accuracy and Production in Milling Keyway in Offset Arm

Dies for Forming a Narrow Channel

By HUBERT R. SCHMIDT

FLAT tool-steel blanks, 0.008 inch thick, were to be bent to a U-shape, with the channel 0.008 inch wide, having a flat bottom and sharp corners at the bends. To do this bending in the conventional way would require a tool with a forming punch 0.008 inch thick, which would be too thin to stand the strain. The accompanying illustrations show the dies used to perform the necessary bending in two operations. Fig. 1 shows the forming tool with the wedge-shaped punch *A*. On the face of the punch and extending its full length is ground a flat, which measures 0.008 inch across, as indicated in the enlarged view in the lower right-hand corner. The pressure pad *B* is backed up by fairly heavy springs. The nest *C* is shaped to correspond with the shape of the piece that is to be formed.

The press is adjusted so that the punch enters the die about 1/32 inch. Then the blank is located in the nest, and the punch enters the die far enough to just bend the blank *W* around the punch, as shown in the enlarged view. The pressure under the pad *B* is sufficient to cause the punch to coin a "flat" 0.008 inch wide. This flat or impression produced by the end of the punch in the bottom of the channel extends the full length of the blank. On the return stroke, the punch carries the work with it, and the operator removes the formed part by hand.

The flat tool shown in Fig. 2 is used for the second or finish-forming operation. This tool consists primarily of a hardened tool-steel die *A*, a hardened stop or gage *B*, the flattening punch *C*, and a dove-

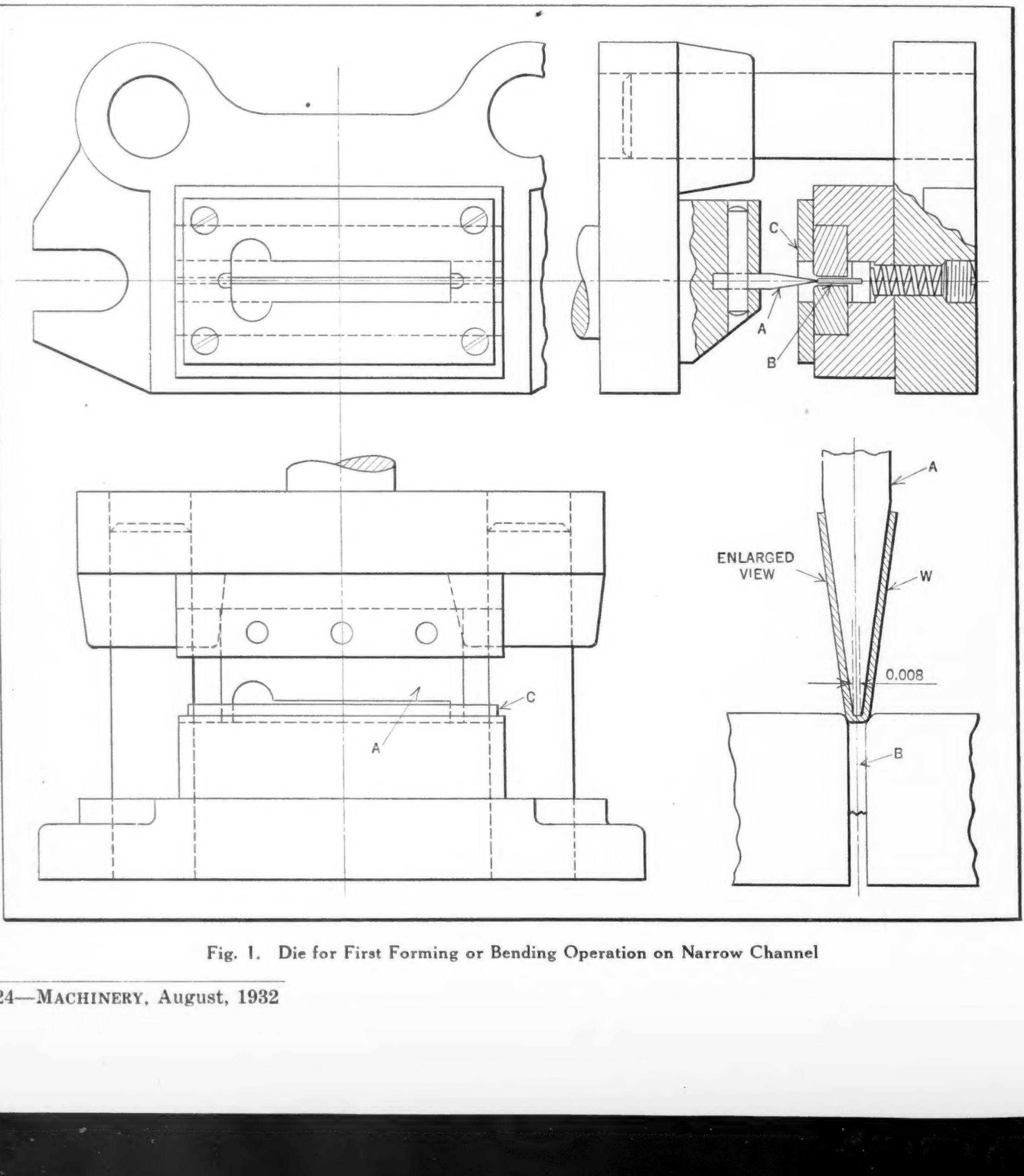


Fig. 1. Die for First Forming or Bending Operation on Narrow Channel

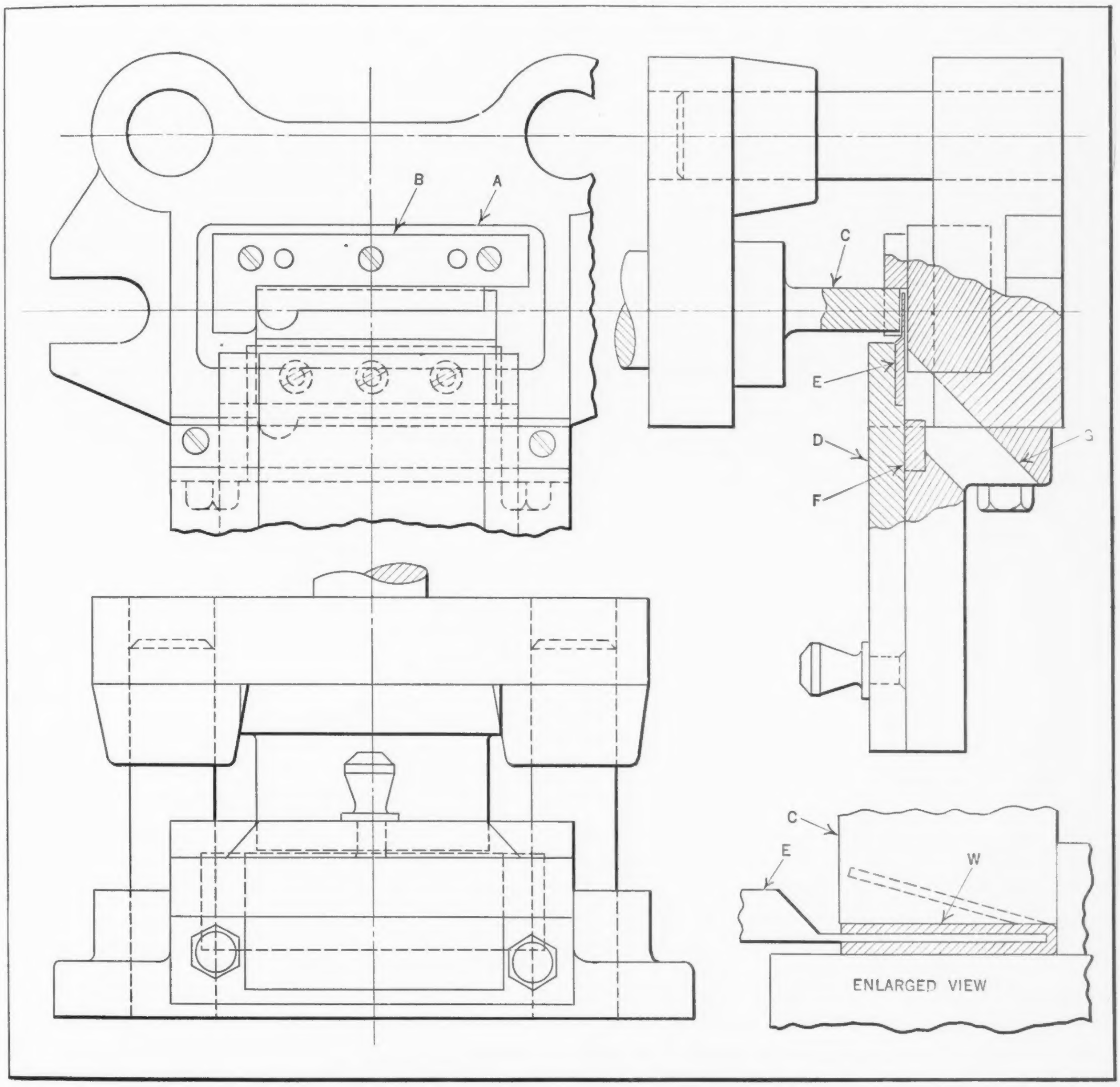


Fig. 2. Flattening Die which Completes the Forming of the Channel W

tail slide *D* of machine steel, to which the blade *E* is attached. Blade *E* is ground until the thin portion is 0.008 inch thick. The temper of this blade is drawn to a blue color. The tool-steel stripper *F* is shaped to suit the blank. When the pieces have been completed, they slide through the opening or chute indicated at *G* into a box located in front of the operator.

In operating this tool, the slide is pulled out until the end of the blade is over the opening or top of the chute, the left hand being used for this operation while the right hand places a partly formed piece on the blade. The slide is then pushed forward until it comes to rest against the stop or gage *B*. Next, the press is tripped and the punch comes down, flattening the blank around the blade *E*. The slide is now pulled out, causing the stripper *F* to force the piece off the blade, so that it falls down the chute *G*.

Standard for Gages Adopted

An American Standard for plain and thread plug- and ring-gage blanks has been approved by the American Standards Association. This standard, which was developed by the American Gage Design Committee, includes terminology and details of construction for plain cylindrical plug-gage blanks and handles; thread plug-gage blanks; plain ring-gage blanks; and thread ring-gage blanks. Copies may be obtained from the American Standards Association, 29 W. 39th St., New York.

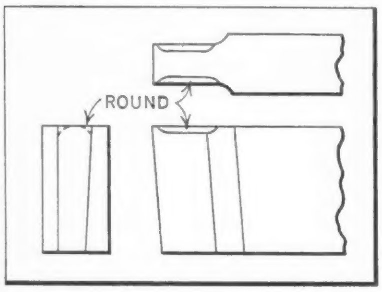
It is of interest to note that the Pratt & Whitney Co. and the Taft-Peirce Mfg. Co. relinquished their patent rights to the tri-lock plug-gage design and a single-unit thread ring-gage locking device, respectively, thus making it possible to incorporate these two designs in the recommendations of the committee.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Recutting a Square Thread

In repairing a screw press, the clamping of the frame caused the threads to be so distorted in the nut that it was difficult to turn the screw. As no lathe with the correct gears for cutting a thread having a pitch of 2/3 inch was available, the method described in the following was used in cutting the thread groove deeper to overcome interference.



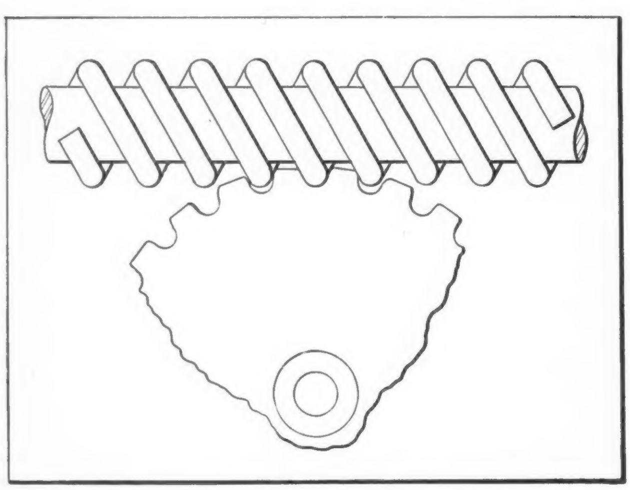
Threading Tool with Side-cutting Edges Rounded so that Tool Cuts Only at End

The top sides of the threading tool were rounded off, as shown in the accompanying illustration, so that the cutting action would be restricted to the front edge of the tool. This tool cut the thread groove to the required depth, while the sides having the rounded edges served to carry the lathe carriage along.

New Britain, Conn. WILLIAM C. BETZ

Coil Springs Replace Worm in Worm Drive

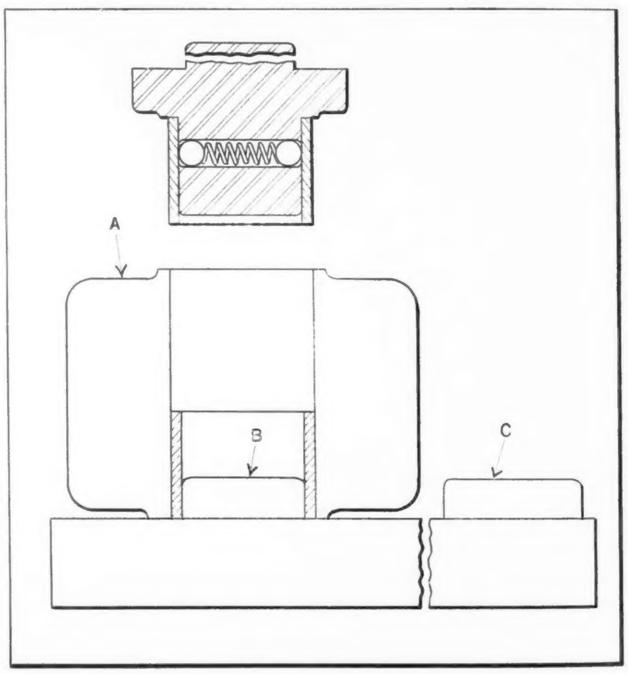
An ingenious application of coil springs in a worm drive may be seen in the accompanying illustration. The worm—if it may be called a worm—consists of two separate springs, properly located relative to each other and wound to fit tightly about the shaft. Contrary to what might be expected, the coils cannot be forced out of place easily. They are always held rigidly by the gripping action of those turns lying beyond contact with the worm-wheel, and can be moved relative to the shaft only by pressure applied at their ends in the direction of the helix. This device is in use as a drive for the turntable on a phonograph.


Coil Springs Wound Tightly on the Shaft Provide a Worm Suitable for Light Duty

Rochester, N. Y. ERNEST C. ALLEN

Assembling Bushings in a Power Press

In one shop, pressing brass bushings into each end of the bracket *A* shown in the illustration was required to be done on a production basis. It was decided to tool up a power press for the job. A punch was made to serve as a holding member for the bushings. Two balls, held against the bushing bore by a spring, keep the bushing on the punch. In the base of the fixture are two pilots *B* and *C*. Pilot *B* is a slip fit in the bushing, and pilot *C* is a slip fit in the bracket bore.



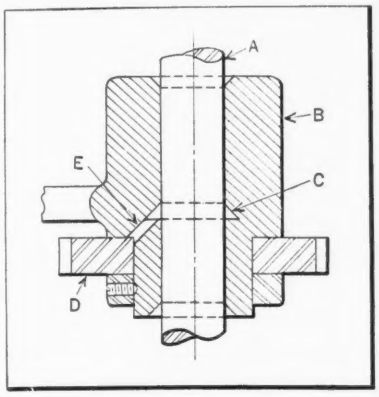
Tools for Pressing Bushings in Both Ends of a Bracket

Bushings are first pressed in at one end of all the brackets. Then the base of the tool is moved so that the other pilot lines up with the punch, after which bushings are pressed into the other ends of the brackets. These tools were found to be very efficient and inexpensive to make.

Rockford, Ill. WALTER E. GUNNERSON

Lubricating an Inaccessible Bearing

Lubricating a gear bearing in a certain machine was very difficult, on account of the fact that the bearing was inaccessible. This difficulty, however, was overcome, as indicated in the illustration, by arranging the oil channels so that the lubricant would pass from an accessible to the inaccessible bearing. At *A* is a steel rod that has a vertical reciprocating movement. This rod runs in a bearing in a fixed bracket *B*, which has a hub that forms a bearing for gear *D*. Gear *D*, which is held in place by a collar, is an idler in a train of gears.



Method of Lubricating an Inaccessible Gear Bearing

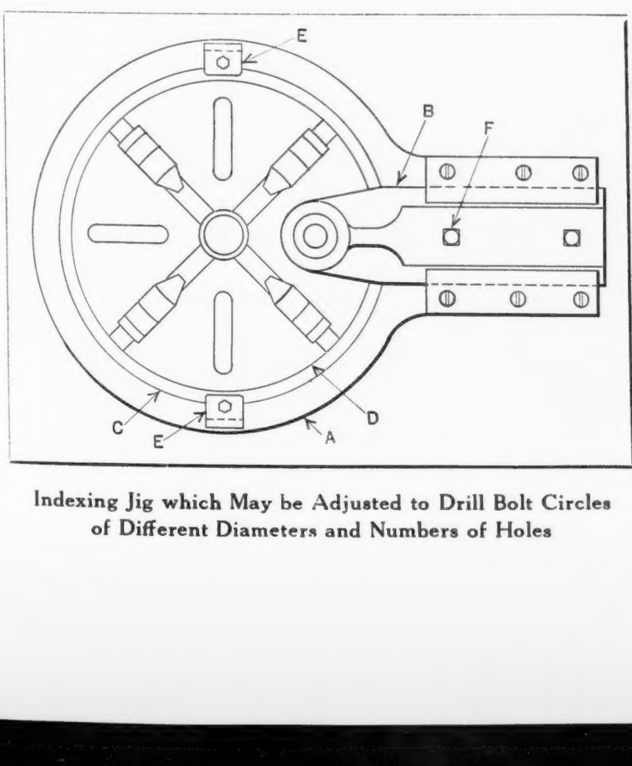
With the present arrangement, both rod and gear bearings are lubricated by applying the oil to the part of the rod above the bracket. An oil-hole is drilled at *E* to convey the oil to the gear bearing. The oil flows into the oil-hole as it is wiped off the rod by the groove *C*. It will be noted that each end of the bracket *B* is countersunk. The countersink at the bottom prevents the oil from being wiped off as the rod moves up, while the upper countersink provides a pocket so that the oil will flow into the bearing as the rod moves down. F. H. M.

Universal Jig for Drilling Bolt Holes

The drill jig shown was made in a shop producing parts having a variety of bolt circles to be drilled. However, the parts were not made in sufficient quantity to warrant a special drill jig. The jig consists of a base *A* to which is fitted the drill bushing slide *B* and a plate *C*. The under side of this plate swivels in the baseplate, and the upper side has a lathe chuck *D* fastened to it. The periphery of the chuck is graduated in degrees, and the chuck may be clamped at any angle by the straps *E*. Bushings of different sizes may be placed in slide *B*.

To set the slide for drilling the required bolt circle, a mandrel is placed in the hole in the center of plate *C* and another in the bushing in slide *B*. The slide is then adjusted, and its position checked by measuring the over-all distance over the two mandrels. The slide is now locked in place by the set-screws *F*, and straps *E* are tightened.

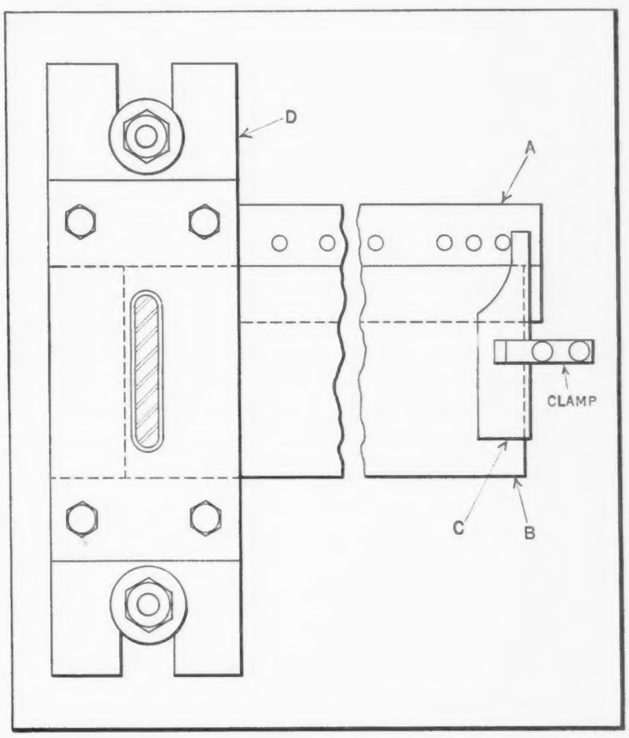
Philadelphia, Pa. C. KUGLER



Indexing Jig which May be Adjusted to Drill Bolt Circles of Different Diameters and Numbers of Holes

Die for Irregular Spacing of Pierced Holes

Owing to the irregular spacing of slots to be pierced in steel strips, it was impossible to employ an ordinary pin stop for locating the work from the slot previously punched. This difficulty was overcome in the following way:



Piercing Die in which Holes are Spaced Irregularly by Stop-pins Corresponding to Spacing of Holes

A guide *A* (see illustration) extending the full length of the strip *B* was attached to the die *D*. Pins were located along the guide in positions corresponding to the required spacings on the strip. A finger *C* was then clamped to the end of the strip and brought in contact with the first pin to locate the strip for piercing the first hole. After this hole was pierced, the strip was pushed up to allow the finger to pass over the first pin and contact with the second. Each hole was located in the same way.

Philadelphia, Pa. R. H. KASPER

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

S. D. J.—If a gear, pulley, or similar part through which power is transmitted must be locked to the shaft by a key, how is the size of the key determined? Are the dimensions, such as width, thickness, and length, determined by fixed rules based on past experience or should the size of a key be related definitely to the shaft strength?

A.—Keys ordinarily are proportioned with reference to the shaft diameter, the most common rule being to make the key width equal to one-quarter of the shaft diameter. The height or thickness of ordinary keys (except the Woodruff form) may equal the width, so that the key is of square section, or the thickness may be somewhat less than the width, in which case the term "flat key" is commonly used. According to the American standard for square and flat stock keys, the width and thickness of square keys equals one-quarter of the shaft diameter for diameters of 1/2, 3/4, 1, 1 1/2, and 2 inches, and the key sizes thus determined are used for a range of intermediate diameters to reduce the number of key sizes. The widths of flat keys are the same as the widths of square keys, but the thickness equals three-quarters of the key width, with slight variations for some sizes. (For dimensions of various sizes, see the table on page 540 of MACHINERY'S HANDBOOK, Eighth Edition.)

For general application or average conditions, the square key will be found satisfactory. Theoretically, even the square form is not thick enough to provide bearing area proportionate to the shaft strength, as will be shown later, but, with the possible exception of some special or unusual applications, square keys and even the flat form have the required strength. We shall consider now, briefly, the general relationship between the strength of a key and the strength of the shaft for which the key is intended.

If the key width equals one-fourth the shaft diameter, the shearing strength of the key will equal approximately the torsional strength of the shaft, assuming that the length of the key is about one and one-half times the shaft diameter, which is generally considered the minimum length. A key of this minimum length, however, would not have a compressive strength equal to the torsional strength of the shaft unless the thickness were over one and one-half times the width, provided all the power were transmitted to the shaft through the key.

In actual practice, the key may do little or no driving (acting primarily as a safeguard) due to the frictional resistance between a tightly fitting shaft and hub. If one of the keyed members is free to slide relative to the other, as in the case of feathers or splines, the key transmits practically all the power, and it is under such conditions that the following method of calculating key sizes may be especially applicable.

Assume that L = key length; W = key width; T = key thickness; D = shaft diameter, all in inches; S = allowable shearing stress, in pounds per square inch (assumed to be equal for shaft and key); and S_c = allowable compressive stress, in pounds per square inch. Then the safe torsional resistance of the shaft equals $\frac{S \times 3.1416 \times D^3}{16}$.

The safe load that a key will transmit, based on its shearing strength, equals $L \times W \times S \times \frac{D}{2}$.

The safe load that a key will transmit, based upon compression, equals $L \times \frac{T}{2} \times S_c \times \frac{D}{2}$. (For Woodruff keys, the amount the key projects above shaft is substituted for $\frac{T}{2}$.)

When Shearing Strength of Key Equals Torsional Strength of Shaft

If the shearing strength of the key is to equal the torsional strength of the shaft, we have:

$$L \times W \times S \times \frac{D}{2} = \frac{S \times 3.1416 \times D^3}{16} \qquad (1)$$

If the key width W is taken as $1/4D$, then the expression for the shearing strength of the key becomes $L \times S \times \frac{D^2}{8}$. If this expression is substituted in Equation (1) and the latter is transposed to determine the value of L, we have:

$$L = \frac{3.1416 \times D}{2} = 1.57D \qquad (2)$$

Therefore, if the key width equals one-fourth the shaft diameter, the length should equal $1.57 \times D$ to make the shearing strength equal to the shaft strength. As will be seen, this length is very close to the minimum length of $1.5D$, which has been very generally used.

When Compressive Strength of Key Equals Torsional Strength of Shaft

If a key is to be designed with reference to its bearing area and so that the compressive strength equals the torsional strength of the shaft, we have the following approximate equation:

$$L \times \frac{T}{2} \times S_c \times \frac{D}{2} = \frac{S \times 3.1416 \times D^3}{16} \quad (3)$$

If the allowable shearing stress S is assumed to equal four-fifths of the allowable compressive stress S_c, then:

$$L = \frac{4 \times 3.1416 \times D^3}{5 \times 16 \times \frac{T}{2} \times \frac{D}{2}} = \frac{3.1416 \times D^2}{5 \times T} \quad (4)$$

Assuming that D equals 4 inches and that a square key is used, the width and thickness of which equals $1/4D$, what key length will be required if the compressive strength of the key is to equal the torsional strength of the shaft? Applying Formula (4),

$$L = \frac{3.1416 \times 4^2}{5 \times 1} = 10 \text{ inches}$$

Assume now that the key is to have a length of $1.5 \times D$; what thickness T will be required to provide compressive strength equivalent to the torsional strength of the shaft? If we transpose Formula (3) (again assuming that $S = 4/5S_c$), we have:

$$\frac{T}{2} = \frac{4 \times 3.1416 \times D^3}{5 \times 16 \times 1.5 \times D \times \frac{D}{2}} = \frac{3.1416 \times D}{15}$$

Hence,

$$T = \frac{3.1416 \times D}{7.5} \quad (5)$$

If Formula (5) is applied to the preceding example, it will be found that the thickness T equals 1.7 nearly. If the minimum key length were $1.57 \times D$, as previously determined (instead of $1.5 \times D$), the thickness T would equal 1.6, or $0.4 \times D$. As W equals $1/4D$, it follows that T equals $1.6 \times W$; consequently, the key in this example would have a width of 1 inch, a thickness of 1.6 inches, and a length of about 6 1/4 inches to make the compressive strength equal to the torsional strength of the shaft.

Chromium-Plated Shaft

A. B.—Is it feasible to run a chromium-plated shaft in a bearing of some other suitable material, say in a hardened steel bushing, where high speeds with bearing loads not in excess of 50 pounds per square inch (operated without lubrication) would be encountered?

Answered by A. Eyles, Moston, Manchester, England

The extreme hardness of chromium-plated surfaces reduces wear, speeds up operation, and in some cases facilitates lubrication. The writer does not know of any metal shaft chromium-plated or treated by the electro-chemical deposition process which will run at high speeds with a load of 50 pounds per square inch, operating without lubrication. The nearest approach to this was a recent test on chromium-plated steel rubbing on a bronze block, lubricated with water, at a speed of only about 60 feet per minute. However, there was no sign of seizure after over fifty hours running. Although intensely hard, chromium-plating is somewhat brittle. It resists shock and vibration poorly, but has a high resistance to pressure and abrasion.

Can a Shop Foreman Bind an Employer as to Price of Repair Work?

K. L.—An industrial plant had an engine and generator damaged by fire, and requested a machine shop to send its foreman to examine the equipment and see how it could be repaired. After an examination, the foreman stated that he thought that the equipment could be repaired, and it was accordingly shipped to the machine shop. The latter sent a bill for $1200 for the repairs, which the industrial plant refused to pay on the ground that the shop foreman had stated that the work would not cost more than $800. The foreman insists that anything he did say was merely in the form of an estimate in respect to price. There was no complaint about the work, and the bill for $1200 was reasonable. Can the machine shop enforce payment?

Answered by Leslie Childs, Attorney at Law
Indianapolis, Ind.

Before the industrial plant can refuse payment of the bill it must show not only that the shop foreman agreed that the work would be done for $800, but that the latter had authority to make such an agreement. If the foreman actually had such authority, or if the machine shop followed a custom of permitting him to make prices, and the industrial plant knew of this and relied thereon, it may have a good defense; at least, it may go to the court or jury on a question of facts. On the facts as they have been stated, however, it seems probable that a court would hold that the office of the foreman was merely to inspect and advise, for the fact that he was a foreman would not, of itself, authorize him to make contracts of this size for his employer. It appears probable that the machine shop may collect. (281 S. W. 185)

* * *

According to the *Economic Review of the Soviet Union*, purchases in this country for the Soviet Union by the Amtorg Trading Corporation during the first half of 1932 totaled only $5,550,000, as compared with $40,590,000 in 1931, and $42,100,000 in 1930. The value of industrial equipment and machinery purchased in 1932 amounted to $2,565,000 as compared with $26,429,000 in 1931. The industrial equipment and machinery orders for June amounted to $342,000—less than one-third of the orders placed a year ago.

Chromium-Plating for Wear Resistance*

A Review of the Results that Have Been Obtained by Chromium-Plating when Applied for the Purpose of Resisting Wear on Tools, Gages, and Machine Parts

By WILLIAM BLUM
Bureau of Standards, Washington, D. C.

WHILE the applications of chromium-plating for appearance are more extensive than for wear resistance, the latter uses are more likely to increase in number and extent. The application of chromium for appearance almost invariably adds to the cost of manufacture. When, however, chromium is applied to reduce wear and to prolong the useful life of a tool or device used in manufacturing, the cost of production is correspondingly decreased.

One of the most successful applications of chromium is on measuring devices, such as dimensional gages. At present many large plants are using chromium-plated plug gages, which have a longer life than any other gages except those of tungsten carbide, which are much more expensive, and more difficult to fabricate.

One advantage of the plated gages is that when they become worn below the permissible tolerance, they can be salvaged by stripping off the chromium coating and replating them. In some plants, just sufficient chromium is applied to afford the exact desired dimension, and in others, an excess is applied, which is reduced to the correct dimension by grinding and lapping. Plug gages can be uniformly plated by using simple precautions. Thread gages are likely to be changed in angle by plating, unless special steps are taken, such as grinding the original gage to a predetermined angle other than the usual 60 degrees.

Greater Accuracy is Assured by Using Wear-Resisting Gages

In estimating the value of chromium-plated gages to industry, the considerable saving in the cost of replacing the gages may be a secondary factor. Far more important is the improvement in the average precision of the product. Before a gage is rejected, it has generally approached or even slightly passed the specified tolerance; hence a certain proportion of the product may be correspondingly inaccurate. If, now, the average life of the gage is increased threefold or fivefold, the proportion of articles of questionable accuracy is reduced.

For several years the standard fifty-meter tapes used by the U. S. Coast and Geodetic Survey have been plated with chromium for a short distance on each side of the gage marks. This coating has not only increased the permanence of these marks, but has also decreased the formation of scratches that might be confused with the gage marks.

Chromium has been successfully applied to forming dies, including those used for drawing nickel and copper tubes and those for shaping sheet metals, especially steel and brass. In addition to increasing the useful life of the dies, the chromium reduces the tendency of the metals to stick to the dies, and thus speeds up production.

Chromium is also very valuable on dies for molding plastic materials, such as rubber, Bakelite, clay, and glass. Such applications depend on the resistance of the chromium not only to abrasion, but also to chemical action, for example by the sulphur, phenol, or other constituents of the plastics.

Owing to the brittleness of chromium, it is not especially adapted for forming operations involving severe impact. If, however, the chromium coating is made relatively thin and very adherent, it may prove advantageous. Experiments at the U. S. Mint in Philadelphia showed that on the dies for stamping nickel coins, a thick coating of chromium was detrimental, but a thin coating, for example about 0.0002 inch, added materially to the life of the dies and to the quality of the coins.

Similarly on rolls for forming foil of soft metals, chromium has proved advantageous. It is doubtful however, whether it will withstand the heavy shock of rolling steel.

Chromium-Plated Cutting Tools

Chromium is valuable on tools like knives and saws that are used for cutting relatively soft but sometimes highly abrasive materials, such as wood, paper, fiber, asbestos, and rubber. It is of doubtful value on metal-cutting tools, as it is difficult to apply a thick enough deposit to be effective without dulling the edge and also causing subsequent flaking of the chromium.

One of the Important Applications is for Printing Plates

One of the outstanding applications of chromium is on printing plates, the wear on which is principally by abrasion. One of the first of such uses was at the U. S. Bureau of Engraving and Printing, where chromium has for years been applied to the plates employed for printing paper currency and postage stamps.

In the present process, the currency plates are electrolytically reproduced, and consist of electrodeposited iron with a surface layer of nickel. Upon the latter, a chromium coating with a thickness of about 0.0002 inch is applied. The life of the resultant plates is about four times that of the plain

*Abstract of a paper read before a meeting of the Franklin Institute, Philadelphia, Pa.

electrolytic plates, and twice that of the casehardened steel plates that were formerly used exclusively for this printing. As the electrolytic plates, including the chromium, cost less than the steel plates, a marked economy has been effected. The impressions are also of superior quality. Chromium is applied directly to the steel plates used for printing stamps. These are stripped and replated several times, thus greatly increasing their life.

Chromium-Plated Machine Parts

While numerous uses of chromium have been suggested on moving parts of machinery, few such applications have been made. On several makes of automobiles, chromium is applied to the piston-pins to protect them against both abrasion and corrosion. Chromium is also used on gears and shafts of small devices, such as speedometers and other counting machines. One objection to the more general use of chromium on bearing surfaces is its brittleness and consequent tendency to flake. It is probable that by depositing the chromium at higher temperatures or by heating the plated articles, this brittleness can be reduced.

One interesting application of chromium that involves moving parts is on the interior of guns of both large and small caliber. At the Frankford Arsenal in Philadelphia methods adapted to hand rifles and machine guns have been developed, while at the Washington Navy Yard numerous six-inch guns have been plated. In general, the plating has resulted in increased life and greater accuracy of the guns. Such coatings are usually not more than about 0.0004 inch thick.

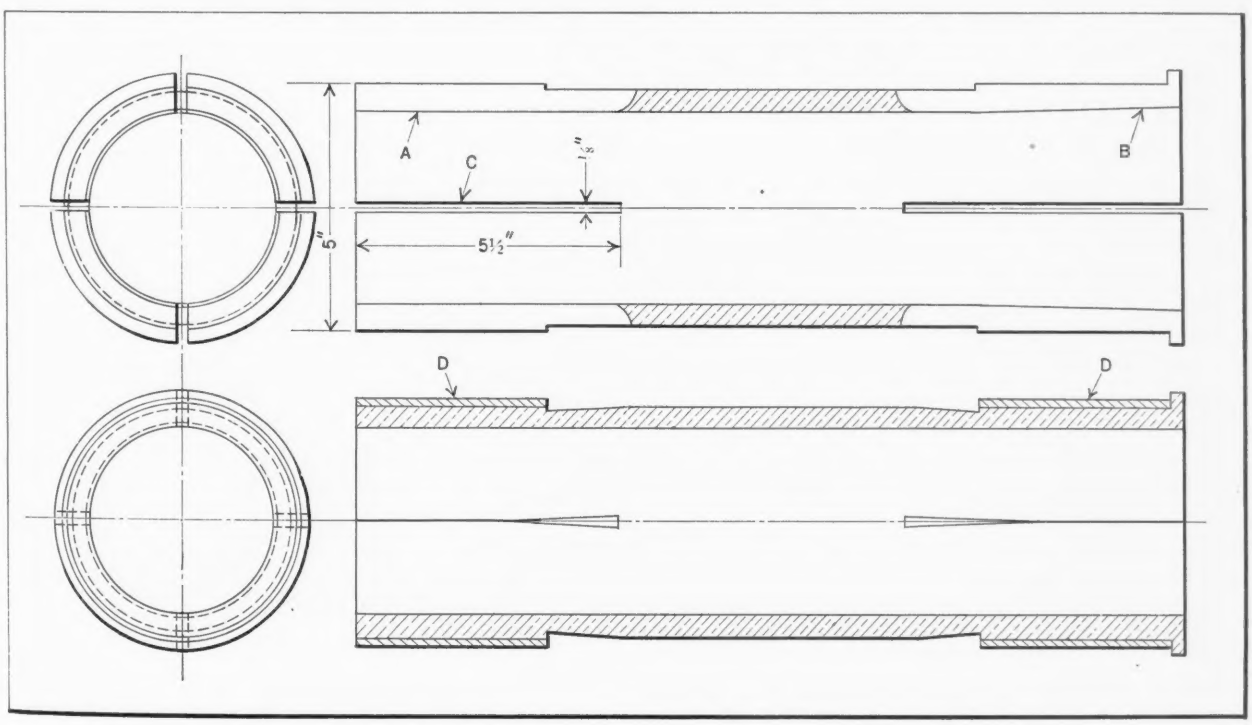
Method of Contracting Worn Bushings for Reboring

By JOHN LARSON

The spindle bearing bushings of a multiple-spindle automatic were worn 1/32 inch large at the points *A* and *B* indicated in the accompanying illustration. To bring the worn ends back to size, the writer cut evenly spaced slots *C* in each end as shown. Bushings *D*, made from a piece of water pipe, were turned down to a diameter of 5 inches, which was the same as the outside diameter of the bearing bushings. The bushings *D* were next bored out to a diameter of 4 7/8 inches and pressed on each end of the bearing, as illustrated in the lower view. The bearings were then bored out to the required size. After repairing the bushings in this way, the machine spindles ran as accurately as when new.

* * *

If high-speed steel tools are used with as much care and attention to details as are given the new carbide tools, the steel tools will be found, in many cases, to be capable of surpassing their previous performance records.



Method of Repairing Bushings that Have Worn Bell-mouthed at A and B

New Methods of Inspecting Gears for High-Speed Transmissions

By DOUGLAS T. HAMILTON, Fellows Gear Shaper Co.

The Procedure Followed in Checking Spur, Helical, and Herringbone Gears for Shape, Spacing, Pitch Diameter, and Eccentricity on a Machine of Recently Developed Design

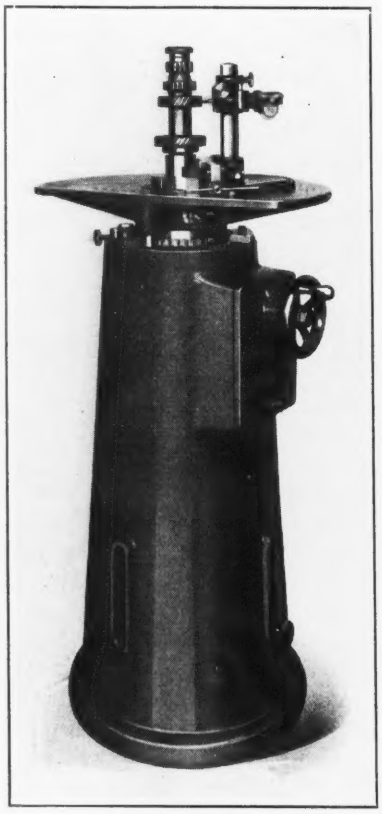


Fig. 1. A Machine that Provides New Methods of Inspecting High-speed Transmission Gears

IN making gears for high-speed units, the shape, spacing, and eccentricity of the teeth require careful checking. With helical and herringbone gears, the helix angle or the lead must also be accurately tested. New methods of checking all these gear tooth elements are incorporated in a machine recently designed by the Fellows Gear Shaper Co., Springfield, Vt. In addition to checking the teeth of gears, this machine is also adapted for inspecting the guides used on helical gear shapers built by the same concern, as well as other units having helical elements. Gears from 2 to 7 inches pitch diameter can be accommodated.

The aim of the designer in developing this gear-checking machine was to obtain simplicity, a wide range of application, and the ability to duplicate measurements within very close limits of accuracy. This was accomplished by providing means of control over the settings of the work-arbor adapter and the fixture carrying the measuring units, which reduces to a minimum the necessity for a high degree of skill on the part of the operator.

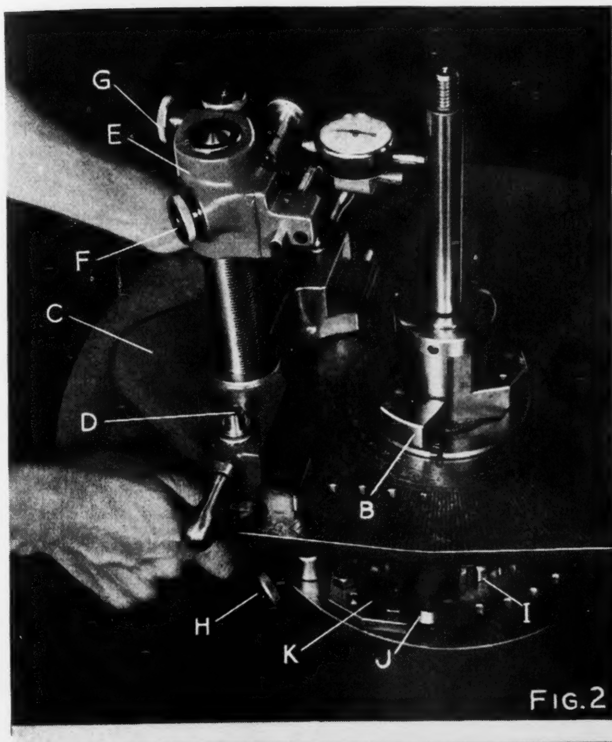
To inspect the involute of a gear tooth, it is compared with a master involute gage. The lead of helical gears can be checked by means of two masters, offset relative to each other, this arrangement also permitting the involute to be checked at the same setting. These offset or stepped masters eliminate any necessity for mathematical computations on the part of the inspector. Leads can also be measured by the sine-bar method, in combination with an accurate index-plate, this method being applicable to helical gears, helical guides, and helical toothed or splined members.

The table of this gear-inspecting machine, which is shown in Fig. 1, is rotatably mounted on a pedestal at a convenient height for the operator. In the center of the pedestal, there is a cylindrical column which carries the work-arbor. This column can be adjusted to different heights through gearing. Accurate positioning of the column, particularly when measuring leads, is obtained by using gage-blocks between a lug on the work-arbor adapter and a feeler gage that is used to gage the contact pressure of the lug against the face of the sleeve. Near the lower end of the pedestal are four adjusting screws which are used for aligning the work-arbor true with the axis of the column and positioning it at right angles to the table top.

A fixture that carries a dial indicator and auxiliary inspection units can be moved about on the table when checking the involute of a gear tooth; fulcrumed to the table when inspecting circular pitch and lead; and rigidly attached to the table when determining the pitch diameter and eccentricity. However, if desired, the machine can be furnished for measuring any one element alone.

How the Work-Arbor Adapter is Aligned with the Column

For aligning the work-arbor adapter with the column, the adapter should be slightly elevated by rotating the handwheel on the front of the pedestal sufficiently to relieve gage projection *B*, Fig. 2, from contact with the face of the sleeve in which the adapter is mounted. This is imperative in all settings, because at no time should the weight of the column be supported by the gage-block projection, and in order to insure that this is not the case, a feeler gage is employed. The base of fixture *C* is then clamped at a convenient distance from the arbor by tightening two studs *D*. Bracket *E* is next brought into a position that will locate the spindle of the dial indicator near the upper end of the arbor. This adjustment is made through screw *F*, after which the bracket is clamped by tightening



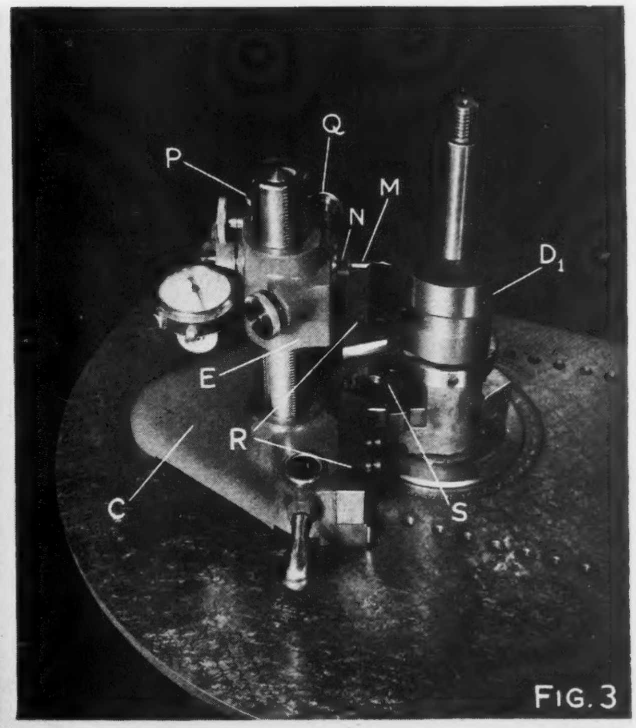


Fig. 2. Aligning the Work-arbor with the Member that Supports it and Positioning it at Right Angles to the Table. Fig. 3. How the Pointer Used in Checking Gear Involutes is Positioned at the Correct Radial Distance from the Work-arbor. Fig. 4. Inspecting the Involute Profile of a Helical Gear Tooth by Means of a Master Involute Gage. Fig. 5. A Stepped Master Involute Gage Enables the Helix Angle of Helical Gears and the Involute Profile of the Teeth to be Inspected at the Same Setting

screw *G*. Screw *H*, which is used to bind a pawl in contact with the index-plate *I*, is then loosened, so that the pawl can be disengaged from the index-plate in order to permit the table to be rotated.

The table is next gripped firmly by both hands, as shown in Fig. 2, and rotated about its axis through approximately 270 degrees, or sufficiently to test the truth of the arbor. In doing this, care should be taken not to strike sine-bar post *J* against block *K* and the rear of the index-plate pawl. Any errors in the alignment of the work-arbor can then be corrected by means of four adjusting screws

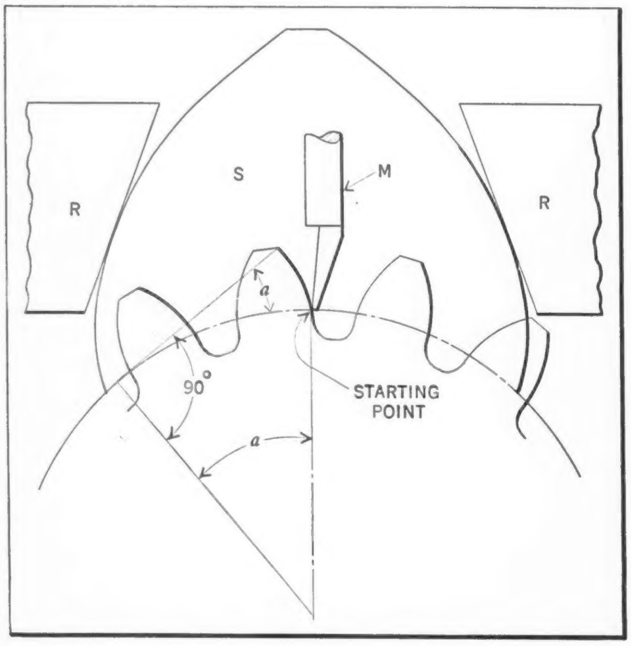


Fig. 6. Diagram that Shows the Angle through which the Pointer Travels in Checking an Involute from the Base Circle of a Gear to the Outside Diameter

near the base of the pedestal, two of which may be seen in Fig. 1.

Setting the Pointer for Checking Involutes

In inspecting involute gear teeth on this machine, a master involute gage is necessary for every different pitch, pressure angle, and number of teeth in the gear. This master *S*, Figs. 3 and 6, is clamped to the work-arbor adapter. A base-circle setting disk D_1 is then located on the arbor in the position that will later be occupied by the gear to be tested. Bracket *E* is next adjusted to the desired height. Binder screw *Q* is then released and pointer *M* is so set that when the fixture is moved about on the table, the pointer will come in contact with disk D_1. Binder screw *Q* is now retightened.

In making this setting, the table should be in the position shown in Fig. 2, with the pawl engaging index-plate *I* and with stop *J* against block *K*. The position of the gage-head bracket should not be changed after making this setting. By swinging the fixture away from the arbor, the setting disk can be removed and the work clamped on the arbor in its place.

Inspecting Involutes of Helical Gears with a Single Master Involute Gage

Before checking the involute profile, it is necessary to determine the setting point of pointer *M*, Fig. 3, in relation to the gear tooth. From the diagram Fig. 6, it will be seen that the pointer will travel through angle *a* in checking an involute from the base circle to the outside diameter. This angle can be determined from the accompanying table after the ratio $\frac{O_d}{B_c}$ has been found. In this expression, O_d equals the outside diameter of the gear, in inches, and B_c equals the diameter of the base circle, in inches.

As an example, assume that the outside diameter of the gear equals 4.125 inches and the base circle diameter equals 3.533 inches. Then ratio $\frac{O_d}{B_c} = \frac{4.125}{3.533} = 1.16757$ inches.

Referring to the table, the nearest value for angle *a* corresponding to this ratio, will be found to be 34 1/2 degrees.

The starting point for tracing the involute with pointer *U*, Fig. 4, depends upon which side of the tooth is being inspected. For the left-hand side, the starting point would be determined by subtracting angle *a* (34 1/2 degrees) from the angle indicated by pointer *U* when pointer *M* is about to leave the gear tooth. For inspecting the right-hand side of the tooth, angle *a* would be added to the angle indicated by pointer *U*.

In order to determine the angle that will be indicated by pointer *U* under the conditions mentioned, guide bars *R* are brought into contact with the master involute gage *S*. Then the pointer *M* is set to the middle of the gear tooth and the indicator needle is positioned at zero. While the contact is maintained between bars *R* and the master, the fixture is moved slowly until pointer *M* is about to leave the top of the tooth. Pointer *U* is then set to that graduated line on the table which happens to be parallel to the face of the fixture, and the angle

Values Used in Locating Involute Pointer at Base Circle of Gears

Ratio $\frac{O_d}{B_c}$	Angle a, in Degrees	Ratio $\frac{O_d}{B_c}$	Angle a, in Degrees	Ratio $\frac{O_d}{B_c}$	Angle a, in Degrees
1.00004	1/2	1.03826	16	1.14116	31 1/2
1.00015	1	1.04064	16 1/2	1.14539	32
1.00034	1 1/2	1.04309	17	1.14967	32 1/2
1.00061	2	1.04560	17 1/2	1.15401	33
1.00095	2 1/2	1.04819	18	1.15839	33 1/2
1.00137	3	1.05084	18 1/2	1.16281	34
1.00186	3 1/2	1.05355	19	1.16729	34 1/2
1.00243	4	1.05633	19 1/2	1.17182	35
1.00308	4 1/2	1.05917	20	1.17639	35 1/2
1.00380	5	1.06210	20 1/2	1.18101	36
1.00460	5 1/2	1.06505	21	1.18568	36 1/2
1.00547	6	1.06809	21 1/2	1.19039	37
1.00641	6 1/2	1.07118	22	1.19514	37 1/2
1.00744	7	1.07434	22 1/2	1.19994	38
1.00853	7 1/2	1.07756	23	1.20479	38 1/2
1.00970	8	1.08084	23 1/2	1.20968	39
1.01094	8 1/2	1.08419	24	1.21461	39 1/2
1.01226	9	1.08759	24 1/2	1.21959	40
1.01365	9 1/2	1.09105	25	1.22460	40 1/2
1.01512	10	1.09457	25 1/2	1.22966	41
1.01665	10 1/2	1.09814	26	1.23476	41 1/2
1.01826	11	1.10178	26 1/2	1.23990	42
1.01994	11 1/2	1.10547	27	1.24508	42 1/2
1.02170	12	1.10922	27 1/2	1.25030	43
1.02352	12 1/2	1.11302	28	1.25555	43 1/2
1.02542	13	1.11688	28 1/2	1.26085	44
1.02738	13 1/2	1.12080	29	1.26618	44 1/2
1.02942	14	1.12476	29 1/2	1.27155	45
1.03153	14 1/2	1.12879	30	1.27696	45 1/2
1.03370	15	1.13286	30 1/2	1.28241	46
1.03595	15 1/2	1.13699	31	....	......

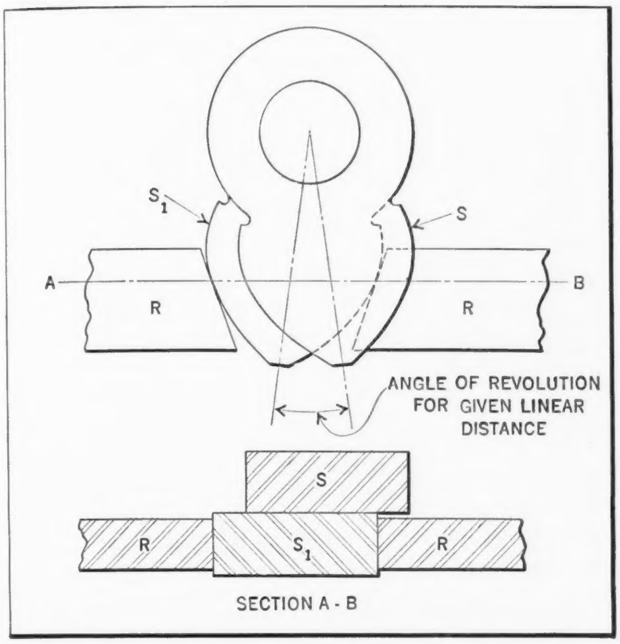


Fig. 7. Diagram that Illustrates the Manner in which Stepped Master Involute Gages are Used for Checking Helix Angles and Involute Profiles

indicated by this line is noted. The angle a is then either subtracted from or added to the designated angle, as previously explained.

To move pointer M to the starting point at the root of the tooth, it is removed from contact with the gear, and the fixture is shifted until pointer U is in line with the angular setting previously obtained. The fixture is now in position for checking the profile of a gear tooth. This is done by slowly moving the fixture to bring pointer M to the top of the gear tooth, at the same time noting the movement of the indicator needle. The indicator is graduated to 0.0001 inch.

Stepped Masters are Used for Checking the Involute and Lead of Helical Gears

By using a two-step master involute gage as shown in Figs. 5 and 7, it is possible to check involute profiles at two points and to check, at the same setting, the lead of a helical gear. The involutes S and S_1 are offset an amount corresponding to a definite linear distance, which information is supplied with the masters. The inspection is done in the same manner as described in explaining Fig. 4.

Lead inspection should, of course, be made on the same portion of the gear tooth at upper and lower settings, or, in other words, the same number of degrees above the starting point indicated by the tracing pointer U, Fig. 4. A gage-block is used to change the height of the work for the two settings. This gage is inserted beneath projection B, Fig. 5, of the work-arbor adapter and a feeler gage as previously mentioned. In lowering the adapter to the gage-block or to the feeler gage, and in making the lower test, care should be taken to see that the projection does not bear too tightly. The column should be so set that the feeler gage can be moved without excessive friction.

How Circular Pitch is Checked

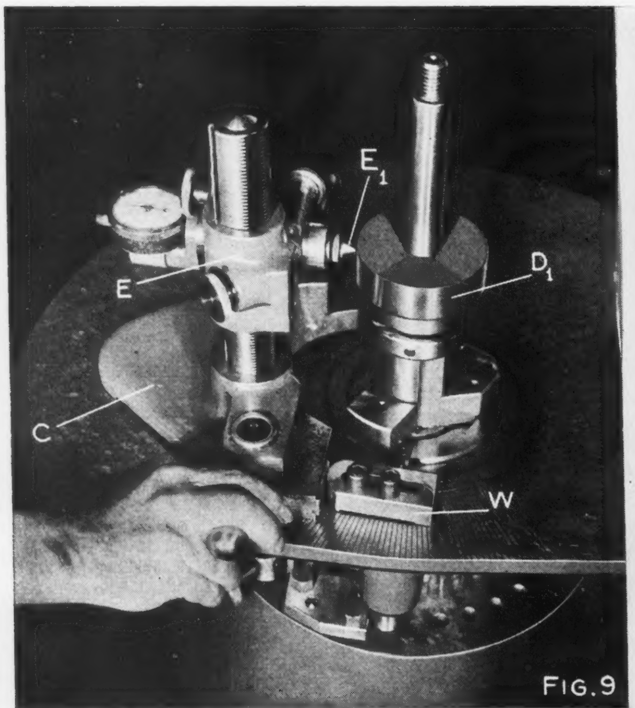
In testing the circular pitch of gears, it is necessary to remove the master involute gage and guide bars and to mount bracket V, Fig. 8, in place to hold a stop pointer. It is also necessary to replace the involute pointer previously used with a ball pointer M_1. Stop-block W is fastened to the table and fixture C is pivoted to the table. The fixture and stop-block are so located that pointer M_1 is midway down the profile of the gear tooth.

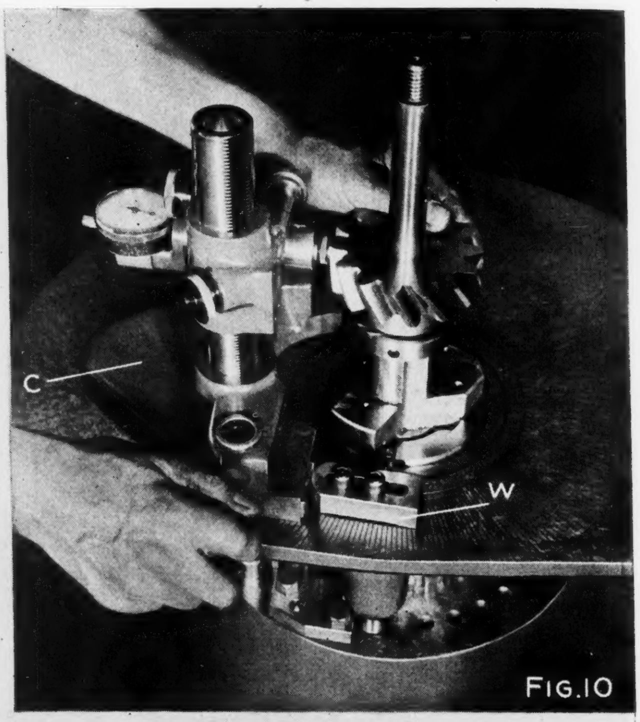
Stop-finger B_1 and tension finger C_1 are next set so that the spring will hold a gear tooth against finger B_1 when the indicator is in contact with the profile of the adjacent tooth. The gear should rotate freely on the arbor. After the indicator has been set to zero and the fixture is moved against stop W, the circular pitch is checked by indexing the gear, tooth by tooth, and noting the movements of the indicator needle.

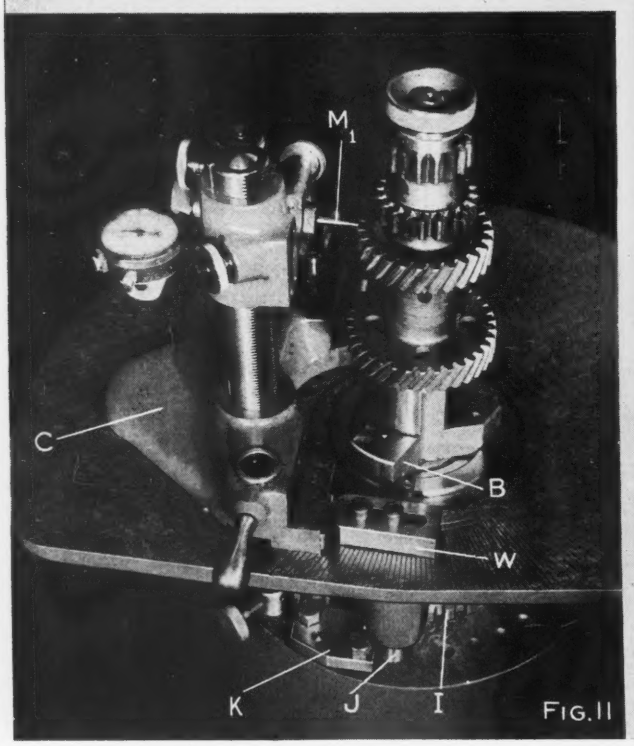
Inspecting the Pitch Diameter and Determining the Eccentricity

For checking the pitch diameter and determining the eccentricity, the bracket required in testing the circular pitch is removed and a cone pointer E_1, Fig. 9, is inserted in bracket E. This cone pointer must be selected for the particular gear to be inspected, and when placed in contact with disk D_1 on the arbor, it is positioned for checking the pitch radius direct. Stop W and the dial indicator are

Fig. 8. Set-up Employed for Checking the Circular Pitch of Gears







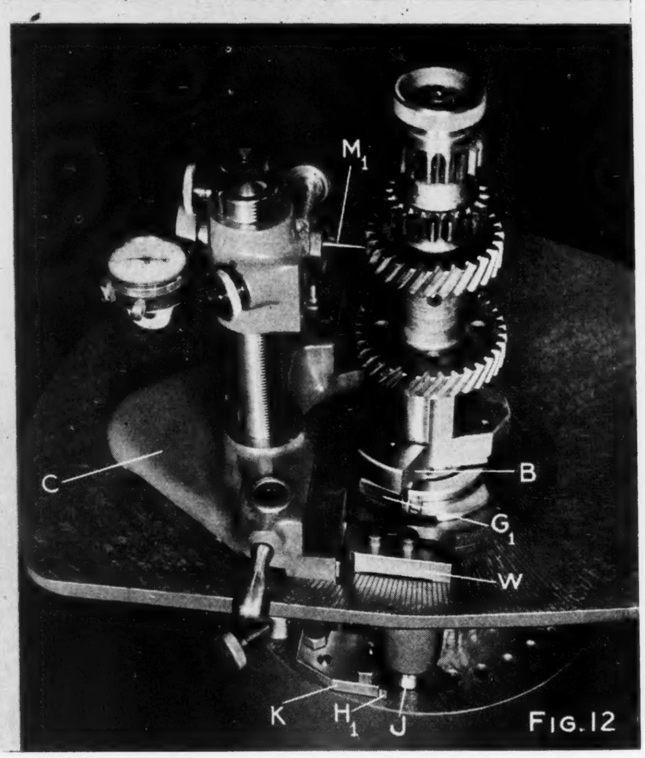


Fig. 9. Method of Positioning the Cone Pointer Used in Checking the Pitch Diameter and Eccentricity. Fig. 10. Checking the Pitch Diameter and Eccentricity of a Helical Gear. Fig. 11. First Setting Employed in Checking the Lead of a Helical Gear Having a Right-hand Helix by the Sine-bar Method. Fig. 12. For the Second Setting of the Helical Gear in Fig. 11, a Gage-block is Placed under the Work-arbor Adapter

next adjusted so that the indicator needle registers zero when pointer E_1 is in contact with the disk. This disk is the same as that used in setting the pointer for involute inspection.

In checking the pitch diameter and eccentricity, the gear is substituted on the arbor for the base-circle disk, as shown in Fig. 10, after which fixture C is brought up against stop W and the cone pointer is placed between the gear teeth. The indicator needle will then show (to 0.0001 inch) the amount that the gear is over or under size on the pitch radius. By indexing the gear from tooth to tooth and noting the indicator readings, the amount of eccentricity can be quickly determined.

A method of testing the lead of helical gears by means of stepped involute masters has been explained; Figs. 11 and 13 illustrate how to check the lead by the sine-bar method. Two settings of the work are required with this method, one with the pointer about 1/10 inch from the bottom edge of the tooth and the other with the pointer the same distance from the upper edge. With these two settings, and the gear clamped stationary, it is required to move the table through an angle V_r between the two settings. This angle is found by means of the formula

$$V_r = \frac{L_d \times T_c \times 360}{L_g \times T_g}$$

in which

V_r = angle of revolution;
L_d = linear distance through which lead is tested;
T_c = number of teeth in cutter;
L_g = lead of gear shaper guide; and
T_g = number of teeth in gear.

As an example, let L_d equal 0.600 inch; T_c equal 27; L_g equal 17.647 inches; and T_g equal 26. Then,

$$V_r = \frac{0.600 \times 27 \times 360}{17.647 \times 26}$$

= 12 degrees 42 minutes 39 seconds

Index-plate *I*, which has thirty-six equally spaced notches, is used in combination with gage-blocks to obtain the second setting of the table. Since the index-plate divisions are 10 degrees apart, two notches would be required in the foregoing example for setting the table approximately. Gage-blocks must then be placed between stud *J* and block *K* as shown at H_1, Fig. 12, to compensate for the difference between 20 degrees and the angle V_r just determined. This difference amounts to 20 degrees minus 12 degrees 42 minutes 39 seconds, or 7 degrees 17 minutes 21 seconds.

The thickness of gage-blocks required can then be determined by the formula:

$$T = \sin V_i \times 5$$

in which

T = thickness of gage-blocks necessary; and
V_i = difference between required angle of rotation and angular setting obtained through the index-plate notches.

(Factor "5" is the distance, in inches, from the center of the column to the center of sine-bar stud *J*.) In the example under discussion, T = sin 7 degrees 17 minutes 21 seconds $\times 5 = 0.12688 \times 5 = 0.6344$ inch.

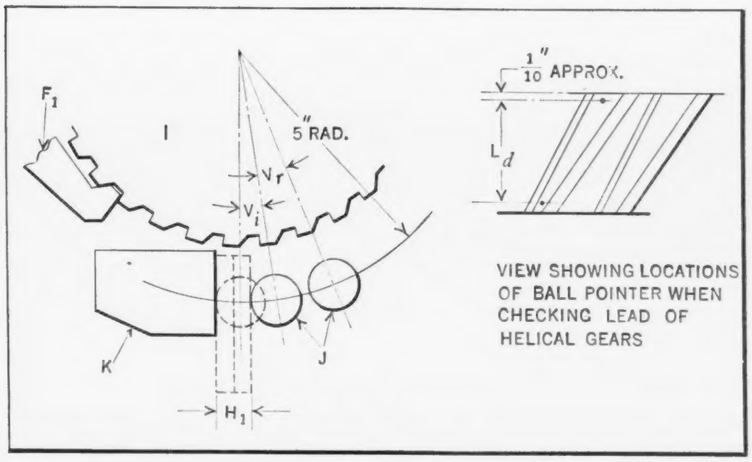


Fig. 13. Diagram Illustrating Method of Determining Angle of Rotation of Table in Checking Lead of Helical Gears and Guides through a Definite Linear Distance

As the gear being inspected in Fig. 11 has a right-hand helix, the first setting of the table is made with stud *J* against block *K*. Then, with a suitable ball pointer M_1 in the fixture, the fixture is clamped to the table in such a position that the pointer will be located midway down the tooth profile and within 1/10 inch of the upper end of the tooth as previously mentioned. Again the column is so positioned vertically that the work-arbor adapter projection *B* rests lightly on the feeler gage held beneath it. The indicator needle is finally set to zero.

In making the second setting, fixture *C* is swung away from the gear, after which the table is elevated by means of the handwheel. Gage-block G_1, Fig. 12 (in this case having a width of 0.600 inch) is next inserted between projection *B* and the feeler gage, so that the gage-block can be moved freely with the fingers. The table is then accurately positioned for the second setting by placing the gage-blocks H_1 between stud *J* and block *K*. In the example being considered, the width of these blocks would, of course, be 0.6344 inch. The fixture *C* is then swung toward the gear until it comes in contact with the fixed stop *W*. If the indicator needle again registers zero in this setting, the lead angle of the gear is correct. Any deviation from zero indicates a circumferential error in the helical path for the linear distance between the two settings, or, in other words, distance L_d, Fig. 13.

If the gear in this case had a left-hand helix, gage-blocks H_1 would have been used in the first setting and stud *J* would have been placed in contact with block *K* in the second setting.

Checking the Lead of Helical Guides

For checking the lead of guides used in Fellows helical gear shapers, the work-arbor is first trued up in the manner explained in connection with Fig. 2; and before locating the ball pointer M_1, Fig. 14, care must be taken to see that projection *B* of the work-arbor rests lightly on the feeler gage held beneath it. The helical guide is then clamped on the arbor and the ball pointer located near the top of the guide, as seen in Fig. 14. Stop *W* on the table is now positioned to locate the pointer midway on the surface of the guide as illustrated, after which the indicator needle is set to zero.

For the second setting of the helical guide, it is customary to use only the notches in the indexing plate, and make the linear distance through which the work is adjusted between the two settings correspond. This practice avoids the necessity of using gage-blocks for the angular measurement, as is required in checking the lead of helical gears by the sine-bar method.

As an example, we will assume that the guide referred to in the previous example is to be checked, this guide having a lead of 17.647 inches. The nearest number of index-plate notches corresponding to the linear distance of 4 inches, which we will assume has been tentatively selected, would be obtained by multiplying this dimension by 36 (number of notches in the index-plate) and dividing by the lead. Thus

$$\frac{4 \times 36}{17.647} = 8.2 \text{ or approximately 8 notches}$$

The actual linear distance for 8 notches equals $\frac{8 \times 17.647}{36}$ or 3.9216 inches.

For the second setting, therefore, the work-arbor is elevated and gage-blocks G_1, Fig. 15 (in this case amounting to 3.9216 inches) are inserted between projection B and the feeler gage. The table is then swung through 8 notches, or 80 degrees, after which the fixture C is pivoted until it comes in contact with stop W. If the indicator now reads zero, the lead is correct, but any deviation from zero will represent a circumferential error in the helical path for the linear distance used in making the test.

The same procedure is followed for checking a guide of the opposite hand, except that the index-plate settings are reversed, as explained in connection with the method of checking the lead of helical gears. An adjustable stop-block K_1 is provided for use in checking a large number of similar guides. This block permits of quickly locating the proper index-plate notch, and makes it unnecessary to lock the index pawl in each setting.

* * *

A Bank that Cooperates

The Madison-Kedzie Trust & Savings Bank in Chicago has recently adopted a novel idea for aiding its customers in their business. One of the bank's large display windows is given over to the showing of a customer's products for a limited time. The Service Tool, Die & Mfg. Co., one of the bank's customers, was asked to plan an exhibit of unusual jobs. The exhibit consisted of sample pieces produced from dies of different types, including Bakelite molding and die-casting dies, gage work, etc. The display created additional business both for the bank and for the manufacturer whose products were exhibited.

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Many British engineers will visit the United States and Canada from August 27 to September 9, in conjunction with the annual summer meeting of the British Institution of Mechanical Engineers, which, this year, will be held in Canada.

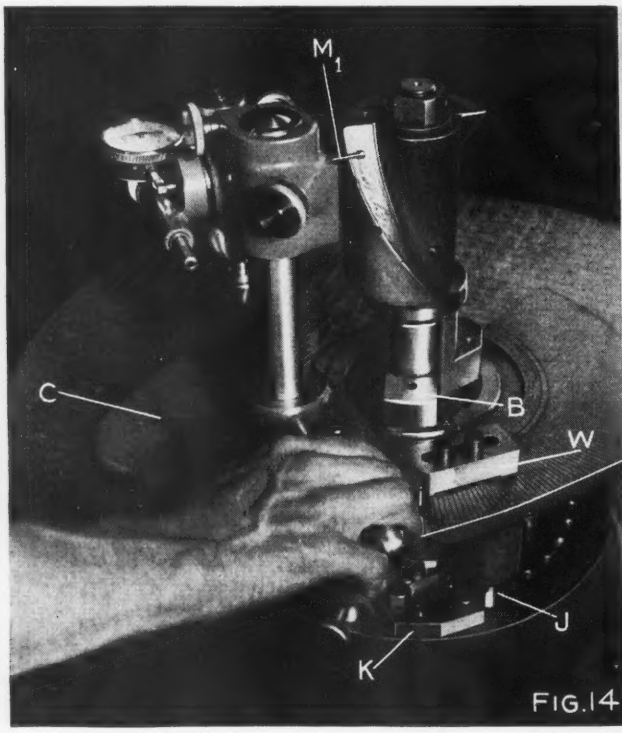


Fig. 14. How the Ball Pointer is Located Near the Top of a Helical Gear Shaper Guide in the First Setting made for Checking the Lead

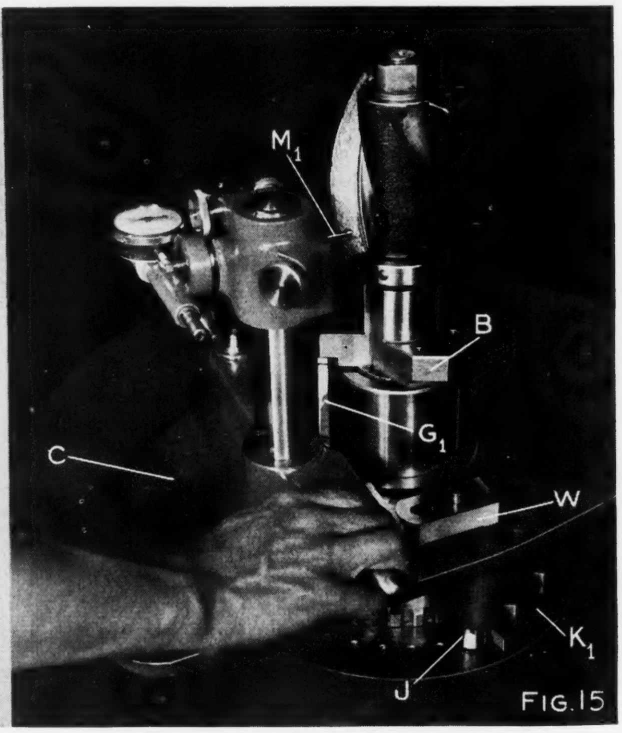
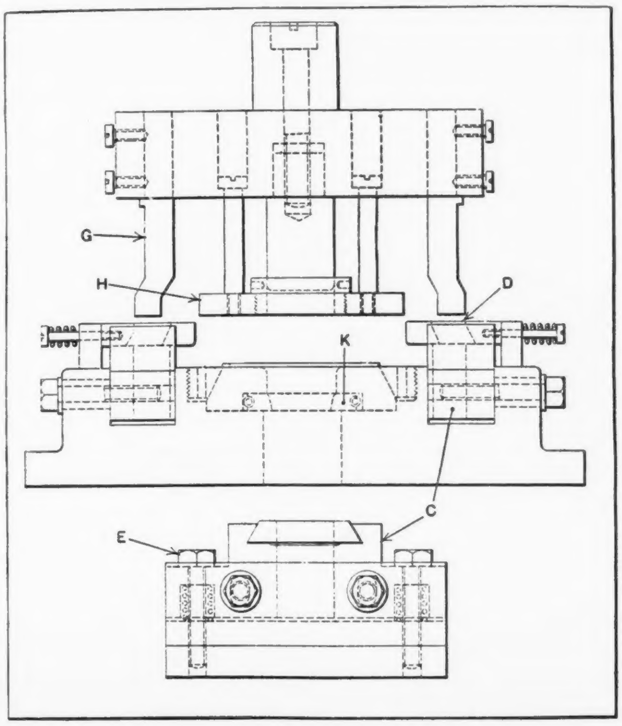


Fig. 15. Second Setting in Checking Lead of Helical Guide, the Work-arbor Having Been Elevated to Bring the Ball Pointer near Lower End of Guide

Blank-Holder for Producing Uniform Blank Pressure

One of the difficulties encountered in performing drawing operations on a single-acting press is that of maintaining a uniform pressure of the blank-holder when it is actuated by a spring or rubber buffer. With these buffers, the pressure exerted on



Drawing Die Having Cam-operated Blank-holder

the blank is greatest where the draw is most severe, and when long draws are made, this usually results in rupture of the shell. However, with the type of blank-holder shown in the illustration, a uniform pressure is exerted on the blank during the entire drawing operation. The drawing members of the die are of standard design.

In the two mild steel blocks *C*, which are a sliding fit in the bolster, are mounted the clamping slides *D*, which are slotted to suit the cams *G* in the punch-holder. These clamping slides are retained in the guides of blocks *C* by suitable stops, and are drawn outward against these stops by spring pressure. Provision is made for adjusting the slide to suit the stock thickness through the screws *E*, which are screwed into the bolster and pass through clearance holes in the blocks *C*. These holes are counterbored to accommodate springs which hold the blocks up while being adjusted. The blocks are locked in position by screws passing through slots in the bolster.

The two cams *G* are made of hardened steel and are a press fit in the punch-holder. The blank-holder *H* is secured to the adapter by four screws which are a sliding fit in the punch-holder. The blank-holder is also provided with an interchangeable guide bushing to suit the diameter of the punch.

In operation, the blank is located in the die and the punch descends until the blank-holder rests on the blank. Continued downward movement of the ram causes the cams to move the slides *D* inward and over the blank-holder, holding the latter in position during the drawing operation.

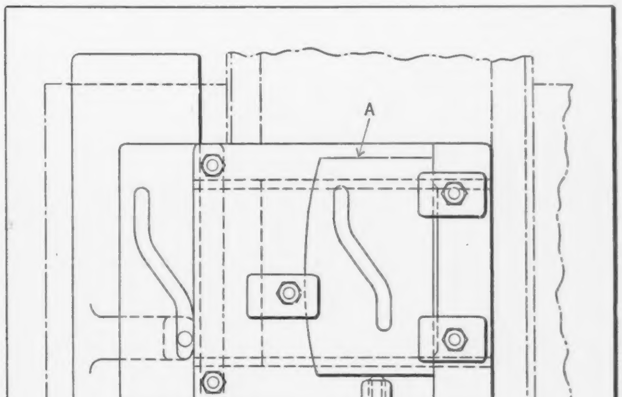
Continuing its downward stroke, the punch forms the shell. As the ram moves upward, the shell is removed from the punch by the strippers *K*. Continued upward motion of the ram causes the cams to force the slides *D* outward, thus allowing the blank-holder to ascend with the die.

* * *

Fixture for Milling Cam Slots of Various Contours

By J. E. FENNO

Inlet and exhaust openings in port plates for a certain type of pump are milled with the set-up here illustrated. The port plate is shown at *A*, clamped in position on the member *B*. This member slides laterally on a mating member bolted to the table of the milling machine. A follower stud, which is secured in a bracket attached to the knee of the milling machine, engages a master cam bolted to the end of the slide *B*. Hence, as the table traverses, the work is given a combined lateral and longitudinal motion, so that the slot in the port plate will be milled to the proper contour. Interchangeable cam plates and followers are provided to suit slots of various contours.



Fixture with Interchangeable Master Cams which Enable a Wide Range of Cam Slots to be Milled

Radiographs for Testing Metals

Rapid strides are being made in the application of radium to the non-destructive testing of metallic materials. Radiographs that show the internal structures of pieces of steel up to 10 inches in thickness can be made. The rays obtained with radium have more than three times the piercing power of X-rays, but the latter produce photographs of better definition and of greater contrast.

Radium is superior in the case of specimens of irregular shape and of varying thickness. When X-rays are employed, a separate exposure must be made of each thick portion, while the thin portions must be covered with a layer of lead sufficient in thickness to prevent the fogging of the negative. In contrast, a radiograph can be made of the entire piece without appreciable blurring.

Radium equipment can be taken easily into confined places where the somewhat bulky and cumbersome X-ray equipment cannot be used. The great cost of radium, however, precludes its widespread use by manufacturing concerns, and for this reason its application for the purpose mentioned will probably be confined to consulting testing laboratories.

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Standards for Punch and Die Sets

The committee on the standardization of punch and die sets, of which Sidney Diamant, president of the Diamant Tool & Mfg. Co., Newark, N. J., is chairman, has published tables and data covering the proposed standard, for distribution to industry, asking for criticism and comment. The proposed standard covers a wide range of sizes in five different styles, chosen with a view to meeting economically the diversified requirements of industry. Besides the dimensions of the die sets proper, guide-post lengths, bushing dimensions, and the design and dimensions of holding clamps are included. Copies of the proposed standard can be obtained by communicating with C. B. LePage, assistant secretary, American Society of Mechanical Engineers, 29 W. 39th St., New York City, to whom comments and criticisms should also be sent.

* * *

We all know that waste of materials is economically harmful to industry; but what of the present waste of the labor of some six million men and women willing to work? Of all our problems, this is the most difficult to solve. Shall we admit that we are incapable of solving it?

The Carbonol Process of Carburizing

The so-called "Carbonol" process of carburizing consists primarily of heating the work thoroughly in a retort and then admitting oil which is caused to impinge on the hot walls of the retort by a rapidly revolving fan. The oil is thus transformed into an active carburizing gas. This method has made considerable progress because it provides a means of obtaining uniform results. An article in September MACHINERY will describe how screw-machine products are heat-treated by this process in automatically controlled electric furnaces equipped for producing carburizing gas from oil.

Another Big Order

The Bureau of Reclamation of the United States Government, Washington, D. C., has just awarded to the Babcock & Wilcox Co., 85 Liberty St., New York City, a contract for $10,908,000 for the fabrication and installation of the welded plate-steel outlet pipes for the hydraulic power and flood control tunnels at the Hoover Dam. The contract involves the fabrication of the largest diameter pipes ever constructed from plates about 3 inches thick and the erection of a plant solely for the purpose on the federal reservation near the dam. The total length of the pipes to be constructed exceeds 12,000 feet, varying in diameter from 8 1/2 to 30 feet.

This is the second largest contract of its kind ever awarded by the Department of the Interior. For its execution, 55,000 tons of plate steel will be required—the largest tonnage involved in any single order so far this year.

* * *

A New Two-Ply Stainless Steel

A two-ply stainless steel known as "Ingoclad" has been brought out by the Ingersoll Steel & Disc Co., Chicago, Ill., a division of the Borg-Warner Corporation. After many years of research, a manufacturing process has been developed by means of which stainless steel with a carbon steel backing is being produced from a composite ingot. The price of the new product will be much less than the price of solid stainless steel, so that it will be possible to make use of the stainless-surfaced steel in many instances where formerly stainless steel could not be used on account of its cost.

It is stated that this two-ply stainless steel can be deep drawn, stamped, welded, formed, and polished. Ingoclad is already being produced in numerous gages and sizes, and it will be supplied later in all commercial thicknesses and sizes of sheets.

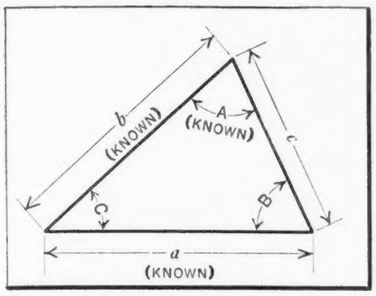
* * *

The advance in the use of lighter materials in engineering construction is becoming quite marked in the electric railroad field. So-called "bullet type," high-speed, light-weight trolley cars have recently been placed in interurban service between Fonda and Schenectady, N. Y. These cars weigh less than half as much as the cars that they replace, and hence require but half as much power for operation. They can be run at higher speeds, the scheduled time having been reduced from 15 to 20 per cent. The cars were built by the J. G. Brill Co. and electrically equipped by the General Electric Co.

Method of Solving Oblique-Angled Triangles

By A. B. COX

The present article describes a "direct" method of solving an oblique-angled triangle when two sides and the angle opposite one of the known sides are given. No handbook or text-book that the writer has seen gives a formula for finding the unknown side of the triangle directly. The formulas generally given require a step-by-step method, and make it necessary to find the unknown angles, although these may be of no interest or value. It is therefore a convenience to be able to obtain the unknown side directly, without having to find the angles.



Known Dimensions of Triangle to be Solved

Referring to the illustration, the angle A and the sides a and b are known. The length of side c is to be found. A formula for this may be derived as follows:

By the rule (or law) of sines,

$$\text{Sin } B = \frac{b \times \sin A}{a} \tag{1}$$

Since the sum of the angles of any triangle equals 180 degrees, we have the well-known relationship

$$\text{Sin } C = \text{Sin } (A + B) \tag{2}$$

Again,

$$c = \frac{a \times \sin C}{\sin A} \tag{3}$$

Substituting (2) in (3),

$$c = \frac{a \times \sin (A + B)}{\sin A} \tag{4}$$

According to well-known trigonometrical formulas,

$$\text{Sin } (A + B) = \text{Sin } A \cos B + \cos A \sin B \tag{5}$$

$$\text{Sin}^2 B + \cos^2 B = 1 \tag{6}$$

$$\text{Cos } B = \pm\sqrt{1 - \sin^2 B} \tag{7}$$

Substituting (1) in (7), we have

$$\text{Cos } B = \pm\sqrt{1 - \frac{b^2 \times \sin^2 A}{a^2}} \tag{8}$$

$$\text{Cos } B = \pm \frac{\sqrt{a^2 - b^2 \times \sin^2 A}}{a} \tag{9}$$

Substituting (5) in (4), we have:

$$c = \frac{a}{\sin A} \times (\sin A \cos B + \cos A \sin B) \tag{10}$$

Substituting (1) and (9) in (10), and simplifying, we get:

$$c = \pm \sqrt{a^2 - b^2 \times \sin^2 A} + b \times \cos A \tag{11}$$

Rearranging this formula for convenience

$$c = b \times \cos A \pm \sqrt{a^2 - b^2 \times \sin^2 A} \tag{12}$$

Since all the quantities on the right-hand side of this equation are known, the length of the unknown side c can be found directly without having to find either of the unknown angles B or C.

This formula always gives two answers to the problem—as all formulas for this case in the solution of triangles should do—and in any given problem it is easy to determine from the practical requirements whether one or the other, or both, of the answers can be used. In any case, the formula is "fool-proof." If there are two practical answers, both will have a plus sign (will be positive). If there is only one practical construction, the practical answer will have a plus sign, and the impractical a minus sign (will be negative). If neither answer is practically possible, the numerical value in the square root will be negative, and no root can be obtained. The last result means that no triangle can be constructed having the values of the sides and angle chosen—in other words, the problem was erroneously stated from the beginning.

The fact that there may be two, one, or no practical answers in the solving of triangles of the type mentioned is, of course, well known and pointed out in handbooks and text-books.

* * *

Simple Constant for Determining Angle Corresponding to Taper Per Foot

By C. M. SCHURMAN

In the general line of machine shop work done in the plant where the writer is employed, a large number of tapers are cut on such work as piston-rods and axles. The drawings usually give the taper per foot only. In order to set the compound rest to the correct angle for these tapers, it is generally necessary to refer to some source of information, such as MACHINERY'S HANDBOOK. For many years, however, the writer has used a constant of $\frac{19}{8}$ for determining the corresponding angle. This constant is approximately correct for tapers ordinarily cut on a lathe.

To illustrate the use of this simple constant, assume that an angle corresponding to a taper of 2 inches per foot is required. The corresponding angle equals $\frac{19}{8} \times$ taper per foot $= \frac{19 \times 2}{8} =$ $4\frac{3}{4}$ degrees. This result is the angle with the center line and must be doubled to obtain the included angle. On page 1030 of MACHINERY'S HANDBOOK, a taper per foot of 2 inches is shown to have a corresponding angle with the center line of 4 degrees 45 minutes 49 seconds, which is very close to that obtained with the constant.

Selecting the Right Drive for Each Machine

Operating Costs of Machine Drives May Greatly Increase Unless Careful Consideration is Given to Selecting the Drive

By VICTOR A. HANSON, Research Engineer
Mechanical Power Engineering Associates

TODAY, more than ever before, attention is being given to the selection of machine drives. The ultimate cost of operating a machine is the one factor by which the types of drives to be employed are judged in any well operated industrial plant.

The engineer in charge of selecting the drives in such a plant considers the operating cost of each machine driven by each type of drive available for that machine. He does not, under any circumstances, adopt any one type of drive as standard for all machines just because that particular type of drive may prove most economical on one or two types of machines.

Important Factors Governing the Selection of the Drive

In determining the ultimate operating cost of machine drives, consideration must be given to the following factors: Installation costs and relative fixed charges; operating efficiency, power factor, and power consumption of motors; operating efficiency of the drives; maximum power load of each machine; average power load of each machine; relative time each machine is in operation and under load, as compared with other machines in the same department; diversity of operation and diversity of peak load on a number of machines which may be grouped; location of machine and possibility of relocating it to utilize a more economical type of drive; degree of machine mobility required; and cost of maintaining motors and drives to prevent breakdown.

Only with these facts, carefully considered and applied, can an engineer hope to operate his plant economically. Of course, there are sometimes other factors such as appearance, which, through enthusiasm of the moment, may seem to overshadow the increase in operating costs. However, there appears to be no record of cases where appearance alone has paid a profit. The difference in operating costs between properly and improperly applied drives may well be the difference between profit and loss, particularly in times of dull business.

How One Plant Arranged its Drives for Economical Operation

How the selection of the right drive for each machine or group of machines results in a direct saving in operating cost is shown by the accompanying table, which will be explained later. The table represents a study made in a plant having typical metal-working operations to perform. This plant, averaging 350 employes, manufactures temperature indicating, recording, and control devices. The metal work includes the production of stampings, forgings, and machined metal parts used in the manufacture of these devices and the building of tools and dies employed in this work. The power-driven machines employed in this plant include the following:

7–18-inch Lathes
4–16-inch Lathes
3–15-inch Lathes
6–14-inch Lathes
1–13-inch Lathe
1–12-inch Lathe
2–11-inch Lathes
1–10-inch Lathe
3– 8-inch Lathes
11–Milling Machines
1–Shaper
1–Planer
3–1-inch Drill Presses
4–1/4-inch Drill Presses
2–1/2-inch Drill Presses
2–4-spindle Drill Presses
5–3-spindle Drill Presses
3–2-spindle Drill Presses
2–Multi-spindle Drill Presses
1–34-inch Blower
1–12-inch Lathe
1–Die-sinking Machine
1–Jig Boring Machine
1–Vertical Turret Lathe
8–Turret Lathes
5–Hand Screw Machines
8–Heavy-duty Buffers
3–Automatics
3–Grinding Machines
1–6- by 6-inch Hacksaw
1–Swaging Machine
1–Riveting Machine
2–Drop-hammers
1–10-inch Belt-type Surfacer
1–Vane Blower
1–Chip Separator
4–Pedestal Grinders
1–600-ton Power Press
1–125-ton Power Press
14–Light Power Presses
1–30-inch Surfacer
8–Heavy-duty Buffers

Group drive is employed on all the machines except a few of the larger ones which are infrequently used, such as a die-sinking machine, a jig boring machine, a vertical turret lathe, and a milling machine. These machines are provided with individual motor drives.

In the group drives, short shafts are used, averaging from 50 to 60 feet in length. There is one 150-foot shaft, but this shaft, containing a number of couplings, is placed with a view to expansion, and can be sectionalized as the load is increased, so that each section can be driven by a separate motor. It is operated as a single unit at present, because of the desire to keep the motor sizes uniform and at the same time to keep the motors properly loaded.

Machines of each type are placed in two or more groups, thus permitting the complete shutdown of one or more groups of each type of machine if it is found advisable to reduce production. Although the motors are connected to the shafts at load centers, the machines are so placed that the motors are mounted over or near the aisles, permitting easy maintenance and replacement if necessary. Frequently, it will be found most economical from the maintenance viewpoint to mount group-drive mo-

tors at the shaft ends in order to locate them over the aisles, where they can be conveniently reached. Short shafts, as a rule, do not require the location of the motors at load centers.

Steel stringers are employed throughout the plant, eliminating realignment of the shafts after they have once been properly installed. In this installation, single 6-inch channels are mounted with the web downward and holes drilled for hangers. This makes a less expensive installation than when two channels are fabricated web to web for each stringer, but it has the disadvantage that the feature of easy relocation without drilling is sacrificed.

The buffing department is group-driven, with the exception of one surfacer that employs a 10-horsepower motor. This motor is used infrequently and its load is comparatively large.

Comparing the Costs of Unit and Group Drives

To determine the economy of the drives employed, a comparison was made of the installation costs between the present combination of group and unit drives and the same machines operated exclusively by unit drives. The results are given in the table.

According to this table, 14 motors are required in the machine shop, and these are operated by group and unit drive. These motors, with control equipment, cost $2490. To convert this department to unit drive exclusively would require 99 motors, costing, with control equipment, $8232. The wiring for the present installation cost $1706. The wiring for unit drive would cost $9039.

The cost of the 9 lineshafts, complete with steel stringers, pulleys, hangers, and belts, installed was $5014. To convert the machines operated by these 9 drives to unit drive would cost $16.075. The latter figure is modified to conform to the price of machines bought for original unit drive equipment, and would be even greater if the change were made from group-driven to motor-driven machines.

Cost Comparison of Machine Drives

Combination Group and Unit Drive		Unit Drive on Each Machine	
Machine Shop			
1-15 H.P., 9-10 H.P., 1-5 H.P., 2-2 H.P. and 1-1 1/4 H.P. motors and controls	$2490	1-15 H.P., 8-5 H.P., 26-3 H.P., 14-2 H.P., 11-1 1/2 H.P., 22-1 H.P., 5-3/4 H.P., 10-1/2 H.P. and 2-1/4 H.P. motors and controls	$8232
Wiring	1706	Wiring	9039
9 lineshaft installations with belts	5014	Adapting machines to motor drive	16,075
Total	$9210	Total	$33,346
Power Press Departments			
1-40 H.P., 1-10 H.P., 1-5 H.P., 1-3 H.P., 2-1 1/2 H.P. and 8-3/4 H.P. motors and controls	$1654	1-40 H.P., 1-10 H.P., 1-5 H.P., 1-3 H.P., 2-1 1/2 H.P. and 8-3/4 H.P. motors and controls	$1654
Wiring	900	Wiring	900
Total	$2554	Total	$2554
Buffing Department			
1-25 H.P. and 1-10 H.P. motors and controls	$533	1-10 H.P. and 9-5 H.P. motors and controls	$1242
Wiring	337	Wiring	726
1 lineshaft installation with belts	635	Adapting machine to motor drive	90
Total	$1505	Total	$2058
Total Installation Cost (All Departments)	**$13,269**	Total Installation Cost (All Departments)	**$37,958**
Annual Operating Cost			
Fixed charges (15 per cent)	$1990	Fixed charges (15 per cent)	$5675
Maintenance (30 motors and 10 drives)	411	Maintenance (123 motors)	1230
Power cost (consumption 219,800 KWH)	3539	Power cost (consumption 219,800 KWH)*	4298
Total Operating Cost	**$5940**	Total Operating Cost	**$11,203**

*The increase in power cost over that for combined group and unit drive is due to the difference in efficiency and to the power factor charge.

In the power press departments, unit drive is employed. The larger presses are unit-driven because of their size, one requiring a 40-horsepower motor and the other a 10-horsepower motor. The smaller presses are unit-driven because of the extreme variation in the number of presses used at one time and the small size of the department, making the proper loading of a group-drive motor difficult. Ordinarily, power presses lend themselves very well to group drive, but in this instance, sometimes only one or two presses are operated for several weeks; yet the full number of presses are required for peak production requirements. As this power press department is increased in size, group drive will be employed.

Thus the installation cost of the combination group and unit drive in the machine shop is $9210, as against $33,346 if unit drive were employed on each machine.

The machines in the power press department are unit-driven; therefore, the same figures are used in both sides of the comparison. In this department, 14 motors are required, costing, with control equipment, $1654. The wiring for these motors cost $900, giving a total of $2554. If, however, group drive had been practical in this department, there would have been a considerable saving in installation cost.

The buffing department employs one motor on group drive and one on unit drive, costing, with controllers, $533. To convert this department to unit drive, 10 motors costing, with controllers, $1242, would be required. The wiring for the group and unit drives cost $337, and for unit drive, $726.

The lineshaft installation, complete, cost $635. To adapt these machines to motor drive, mounting the motors on the ceiling, would cost $90. If the motors were mounted on the machines, this cost would be increased considerably. The total cost for the group and unit drive installation in this department is $1505, as compared with $2058 if unit drive only were used.

For all the departments, the total installation cost of the combination group and unit drive is $13,269. The total cost of a unit drive installation would be $37,958, or 286 per cent of the present installation costs.

Carrying the comparison of costs into the operation of the plant, fixed charges of 15 per cent, including depreciation, interest, taxes, and insurance, amount to $1990 for the present combination of group and unit drive, and $5675 for the unit drive installation.

The maintenance cost for the present installation is $411 per year, whereas for the unit drive installation it would be $1230.

The annual power cost of the present combination of group and unit drive amounts to $3539. The efficiency of the motors weighted for motor size is 88.5 per cent, and the power factor is 85 per cent. The efficiency of the unit drive weighted for motor size is 81.4 per cent giving a difference in motor efficiency of 7.1 per cent. Deducting a lineshaft loss of 3.5 per cent, a difference of 3.6 per cent still exists, adding $127 to the power bill.

The power factor developed is estimated at 64 per cent for the unit drive, which adds $632 to the power bill when a power factor charge is made.

The total annual operating cost for the combination group and unit drive is $5940, as compared with $11,203 if unit drive were employed exclusively.

Thus it can be easily seen that the general use of motors for unit or individual drives without a study of transmission requirements and possibilities may easily turn out to be a very expensive installation. Only with a full knowledge of the operating conditions and costs of each machine, can drives be designed and installed to operate those machines economically, and, as a rule, the use of group drives provides unusual opportunities for economies.

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The Broadening Application of Bakelite

More than seven hundred different Bakelite materials with widely varying physical properties are in use today. These materials meet the requirements of a wide range of mechanical applications. September MACHINERY will present many examples of how Bakelite materials are solving problems in machine design. This article will also give, in convenient form, tables pertaining to the properties and uses of different grades of Bakelite, as well as the strength, hardness, etc., of the different materials. The article contains just the information that the engineer, designer, and mechanical executive wishes to have available on this material, which is constantly finding so many new uses in industry.

Russian Plants Ready for Operation

A number of plants in the machine-building field in the Soviet Union have been completed, ready for operation, according to the *Economic Review of the Soviet Union*. Among these are the first section of the Moscow ball-bearing plant and of the Frazer milling machine plant in the same city; several sections of the Caliber measuring instrument plant in Moscow; part of the Nizhni Novgorod milling machine plant; a Diesel-engine plant in Voronezh; and an automobile plant at Nizhni Novgorod.

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Industrial Machinery Exports

Returns covering the exports of industrial machinery from the United States during the last few months have shown an unusually constant market, even though the figures are considerably below the averages for past years. The monthly average for 1932 is slightly above $5,000,000, the May exports, the last month for which complete figures are available, being, according to the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, $5,180,000. This is a slight gain over the figure for April, which was $4,870,000. In the total for May, the value of metal-working machinery was $945,000. This is lower than for previous months, due largely to the small recent exports to Russia.

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By using steel straps for tension members and channels or T-sections for compression members, and welding the entire structure, a roof truss of simple construction, one-third lighter than former trusses but having equal strength, may be constructed. This is one of the developments of the Westinghouse engineering staff.

NEW TRADE  LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies Can be Obtained by Writing Directly to the Manufacturer, Mentioning MACHINERY.

INTERCHANGEABLE COUNTERBORES. Continental Tool Works Division of Ex-Cell-O Aircraft & Tool Corporation, 5835 Martin Ave., Detroit, Mich. Catalogue CT-132, featuring all types of interchangeable counterbores, core drills, inverted spotfacers, and special tools. The cutters furnished with the counterbores are of the conventional type. In addition to the standard cutters, inserted-blade cutters and tungsten-carbide tipped blade cutters are shown for use on special production jobs.

SMALL TOOLS. Greenfield Tap & Die Corporation, Greenfield, Mass. Catalogue 32, covering the entire line of small tools made by this company, which includes taps, dies, screw plates, twist drills, reamers, gages, pipe tools, and miscellaneous tools. A number of new tools are shown in this catalogue for the first time. Tables and data on the uses and applications of small tools are included. The book is indexed for ready reference.

BENCH LATHES AND SCREW MACHINES. Hardinge Brothers, Inc., Elmira, N. Y. Bulletin A, illustrating and describing Cataract standard bench lathes. Circular descriptive of Cataract precision hand screw machines. Circular illustrating and describing various attachments for Cataract bench lathes, including chucks, faceplates, driving dogs, screw-cutting attachments, grinding attachments, etc.

METAL TREATMENT. American Metal Treatment Co., Elizabeth, N. J. Circular outlining the service offered by this company, which includes metal-treating processes of various kinds, such as carburizing, annealing, normalizing, hardening, tempering, gun metal or Carbonia finish, bright annealing, nitriding, and the combination process of nitriding and carburizing known as "Ni-Carb-Casing."

OPTICAL INSTRUMENTS. Bausch & Lomb Optical Co., Rochester, N. Y. Catalogue descriptive of instruments for spectrographic analyses. The book describes in detail the use of the spectrograph in the analytical laboratory. A bibliography is included, listing various articles and books describing the different uses of the spectrograph, including its applications in the industrial field.

DESIGNING SERVICE AND SPECIAL MACHINES. City Machine & Tool Works, E. Third and June Sts., Dayton, Ohio. Circular entitled "Frozen Assets," outlining the service offered by this concern, which includes the designing and manufacturing of dies, jigs, fixtures, gages, special machinery, and other general tool-room products.

MOTORS. Master Electric Co., 100 Davis Ave., Dayton, Ohio. Bulletin on Master geared-head motors for gear reduction or acceleration. Circular entitled "Fortify Your Dealers with Master Motor Facts," outlining the merchandising service offered by the concern for the manufacturer, the jobber, and the dealer.

CHUCKS. Garrison Machine Works, Inc., Dayton, Ohio. Circular entitled, "Garrison Made Gear Chucks," illustrating and describing different types of chucks designed especially for holding parts having teeth or threads. Circular entitled "What is Silence Worth?", outlining the advantages of ground-tooth gears.

ELECTRIC WELDING MACHINES. Federal Machine & Welder Co., Warren, Ohio. Circular entitled "Steel Barrels Manufactured by Electric Resistance Welding," describing the process and the equipment used. The circular is a reprint of an article by M. L. Eckman, research engineer of the company.

MAGNETIC CLUTCHES. Dings Magnetic Separator Co., Milwaukee, Wis. Bulletin treating of the installation and use of magnetic clutches for special and general power-transmission applications. The bulletin describes three types of magnetic clutches—single disk, multiple disk, and serrated disk.

MOTORS. Wagner Electric Corporation, 6467 Plymouth Ave., St. Louis, Mo. Bulletin 174, Part 5, descriptive of Wagner multi-speed squirrel-cage motors, which are made in open and totally enclosed fan-cooled types. The illustrations show installations of the various types.

COPPER AND BRASS PRODUCTS. Revere Copper and Brass Incorporated, 230 Park Ave., New York City. General catalogue covering the complete line of Revere copper and brass products. The book is provided with both a classified and an alphabetical index for ready reference.

CHISELS. Paragon Steel & Tool Co., East Rutherford, N. J. Circular announcing chisels made from a super alloy tool steel for use in connection with pneumatic hammers. The circular also gives data on hollow drill steel, hand drills, and similar tools.

BAND SAWS. Racine Tool & Machine Co., Racine, Wis. Circular illustrating the Racine duplex portable band saw, which is adapted for cutting either wood or metal. Circular illustrating and describing Racine high-speed, draw-cut, metal-cutting machines.

MATERIALS-HANDLING EQUIPMENT. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Circular illustrating the application of the Cleveland overhead tramrail system for moving roll products.

STEEL. Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill. Ryerson Journal and Stock List, describing the various brands of steel made by the company, and listing the new extras on bands, the new cold-finished steel extras, the new hot-rolled cutting extras, and other information of value to the steel user.

ELECTRIC EQUIPMENT. Allen-Bradley Co., Milwaukee, Wis. Bulletin 609, illustrating and describing the Allen-Bradley hand-operated starting switch for manually switching small alternating-current motors directly across the line.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Circular GEA-1583, entitled "Relays Step Forward," outlining the features of the electric relays made by this concern and the characteristics of the different types.

WELDING EQUIPMENT. Thomson-Gibb Electric Welding Co., Bay City, Mich. Bulletin 136, illustrating and describing equipment for direct heating by the electric resistance method, which was developed for the rapid soldering of parts.

MOTORS. Lincoln Electric Co., Cleveland, Ohio. Circular entitled "The Stainless Steel Motor," descriptive of the Lincoln "Linc-Weld" Type E induction motor, the walls of which are of stainless steel and rolled plate.

GEAR INSPECTION EQUIPMENT. Fellows Gear Shaper Co., Springfield, Vt. Bulletin illustrating and describing an automatic machine known as the "Red Liner" for inspecting gears and charting a permanent record of all errors.

SELF-LOCKING SCREW THREADS. Dardelet Threadlock Corporation, 120 Broadway, New York City. Bulletin 5, illustrating and describing in detail the Dardelet self-locking screw thread—its advantages and applications.

ELECTRIC MEASURING INSTRUMENTS. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Bulletin 871, containing data on temperature measurements in generators, transformers, and cable systems.

MOTORIZED SPEED REDUCERS. Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill. Circular describing Janette motorized speed reducers for application to motor-driven slow-speed machines.

CONTROL EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Circular describing the operation and construction of the new Polaricode split-second supervisory control.

CRANES. Whiting Corporation, Harvey, Ill. Catalogue 214, covering the Whiting line of electric and hand-power traveling cranes, which are made in capacities of from 3 to 350 tons.

MOTORS. Reliance Electric & Engineering Co., Ivanhoe Road, Cleveland, Ohio. Bulletin 112, illustrating and describing Reliance fully enclosed fan-cooled Type AA induction motors.

GEAR CHUCKS. City Machine & Tool Works, E. Third and June Sts., Dayton, Ohio. Folder illustrating and describing Bolender chucks for grinding and boring helical and spur gears.

MOTOR PUMPS. Ingersoll-Rand Co., 11 Broadway, New York City. Circular briefly describing the Cameron motor pump, which is made in sizes of from 1/4 to 25 horsepower.

BALL-BEARING PILLOW BLOCKS. Dodge Mfg. Corporation, Mishawaka, Ind. Bulletin A-117, descriptive of the Dodge Type DH-1 ball-bearing self-aligning pillow block.

LUBRICANTS. Acheson Oildag Co., Port Huron, Mich. Technical bulletin treating of the properties, uses, and advantages of colloidal graphite as a lubricant.

Do You Know

that seamless steel pipe can now be drawn in diameters up to nearly 5 feet and in lengths up to 28 feet?—see page 887.

how a group piece-work system was made to work successfully?—see page 886.

what denitriding is and how it is done? —see page 921.

that free-wheeling has necessitated the introduction of entirely new methods in making rolls of the required capacity and finish?—see page 881.

what rules to use for determining the size of key to use when transmitting power by means of gears and pulleys? —see page 928.

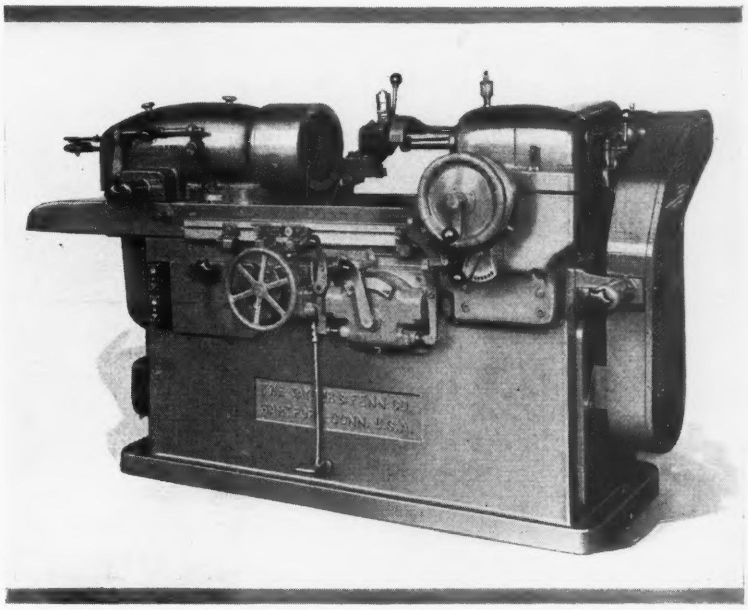
what success has been obtained in applying chromium-plating for wear resistance?—see page 930.

that tungsten carbide is being used successfully for parts subjected to wear, as well as for cutting tools?—see page 909.

how to preserve stored rubber belts? —see page 885.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances Recently Placed on the Market



Taylor & Fenn Hydraulically Operated Internal Grinder Designed Especially for Short-run Work

Taylor & Fenn Short-Run Internal Grinder

A hydraulically operated internal grinder intended for use in shops where short-run work of a variety of types and sizes is the rule has been produced by the Taylor & Fenn Co., Hartford, Conn. Flexibility, simplicity, operating convenience, and accuracy are the advantages of the design. Straight and tapered holes can be ground up to 8 inches in diameter and 8 inches in length.

A particular feature of the machine is that the work reciprocates instead of the wheel-head. In grinding operations, the wheel contacts with the back of the hole. Two ball bearing motors, enclosed within the base, drive the machine. One of these, rated at 5 horsepower and running at 1200 revolutions per minute, drives the hydraulic pump and the grinding wheel spindle, while the other, rated at 1 horsepower and running at 900 revolutions per minute, drives the work-head spindle.

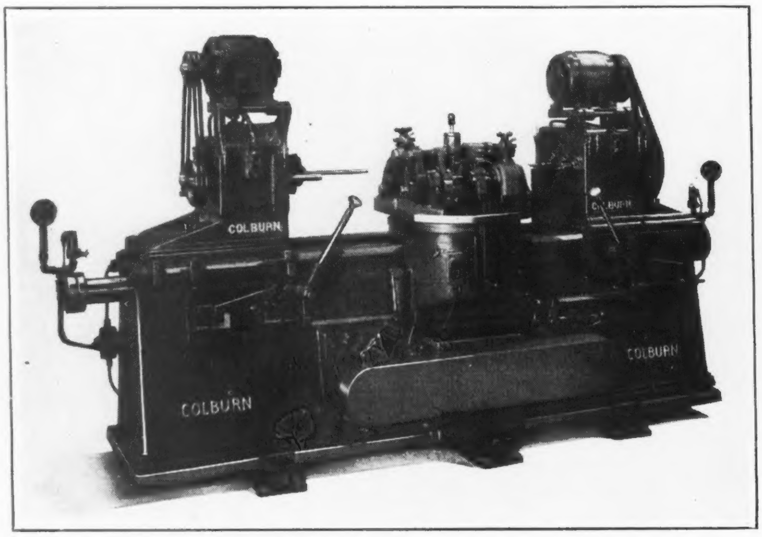
The table that carries the work-head is reciprocated hydraulically, the grinding-wheel feed-screw also being actuated hydraulically. Table speeds ranging from 0 to 44 feet per minute are obtainable through a throttle valve, which admits oil under pressure to a piston type reverse valve that is controlled by means of adjustable table dogs. When desired, as in setting up new work, the table can be moved by hand.

The work-head can be swiveled 15 degrees for taper grinding. Two standard speeds of 275 and 760 revolutions per minute are provided through the pulley on the work-spindle. This pulley is supported in a way that relieves the spindle of all belt pull.

Starting and stopping of the work is controlled through a single lever that engages and disengages a clutch assembled in the spindle pulley. The same lever controls the automatic flow of coolant, which is supplied to the wheel and work from a portable tank equipped with an independent motor. A 1 1/8-inch hole extends through the spindle to accommodate the chuck-operating tube and the coolant supply pipe.

The cross-slide unit, which carries the grinding wheel, jack-shaft and belt tightener, is mounted on vee and flat ways and is supported by a heavy bridge, rigidly attached to the base. The hydraulic power cross-feed can be made to operate at each end of the table travel or at one end only. Provision is also made for a rapid manual movement of the cross-slide. Wheel-heads of quill, naked, and sleeve types can be furnished to suit different classes of work.

This machine has a maximum swing over the table of 16 inches, and a maximum table traverse of 20 inches. The weight, complete with motors, is 5375 pounds. The machine will be marketed by the agency sales division of the Pratt & Whitney Co., through its representatives in various cities.



Colburn Hydraulically Operated Precision Boring Machine Designed to Use Diamond or Tungsten-carbide Tools

Colburn Hydraulic-Feed Finish-Boring Machine

A machine designed for the precision boring of holes in small parts by using diamond or tungsten-carbide tools is being introduced on the market by the Consolidated Machine Tool Corporation of America, Colburn Division, Rochester, N. Y. This machine is intended especially for the rapid production of parts made from cast iron, non-ferrous metals, and other materials, such as fiber. One of the particular features is the hydraulic cycle of operations.

The machine illustrated is equipped with five spindles, three of which are in the right-hand head and two in the left-hand head. They bore five straight holes in three different parts. The spindle heads are fed to the work for the boring operation, the work-table remaining stationary. Each head has independent feed and traverse movements. Thus, in conjunction with the indexing table, which carries two sets of holding fixtures, all spindles in both heads can work simultaneously on parts loaded in one set of fixtures, while the other set is being reloaded. The operation is practically continuous, as only a little time is required for indexing the table. Because of the automatic hydraulic cycle, all that the operator has to do is to index the table, start the cycle, and reload the parts.

The machine illustrated was built for finish-boring the cylinder, piston, and connecting-rod of electric refrigerators. The hydraulic equipment employed for the feed and traverse of the spindle heads is driven by a single motor, the two hydraulic pumps and the motor being located in the base. The motors that drive the spindle heads transmit the power smoothly through multiple-vee belts. Spindle speeds up to 2620 revolutions per minute provide cutting speeds up to 300 feet per minute. The feed rate of the spindle heads is variable from zero to maximum, and can be quickly set to the rate that is most efficient for the job.

Different numbers of spindles and types of indexing tables can be furnished to suit the production required and the variety and size of the parts to be finish-bored.

Heald Vertical Internal Grinding Machine

A No. 90 heavy-duty internal grinding machine of vertical style has been recently designed by the Heald Machine Co., Worcester, Mass., for the accurate finishing of large work. It is built particularly for parts that would be awkward to handle in a horizontal position or for work that would have too great an overhang. The machine will grind straight or to a taper, internally or externally, and can also be used for face-grinding.

Two types of wheel-head drive can be furnished. The drive shown is the usual Heald idler-pulley arrangement; this is necessary when a considerable range of spindle speeds is required. For large heavy-duty spindles with big grinding wheels, the wheel-head would generally be coupled direct to the motor and the idler-pulley arrangement would be eliminated.

The vertical wheel-head slide is operated hydraulically. It is controlled through the reverse control valve arrangement on the right-hand side of the head. An elevator lock prevents the slide from falling when the hydraulic system is shut off. On the standard machine, the wheel-head slide can be swiveled up to 15 degrees, either to the right or to the left.

The slide is counterbalanced hydraulically by means of valves. This insures a uniform speed up or down during an operation and also equalizes the hand effort required to move the slide. The slide stroke is governed by two dogs. A 25-horsepower motor drives the wheel. The hydraulic system is operated by an independent motor, which drives a pump mounted on the lower right-hand side of the column.

While the machine illustrated is equipped with a 36-inch faceplate, it can also be furnished with a 48-inch size. Columns of various heights are provided to give clearances of 15, 18, 24, and 38 inches between the truing diamond and the faceplate.

Either machine can be arranged for 22 or 31 inches of grinding stroke.

The chuck driving shaft is driven through Texropes by a five-horsepower variable-speed motor. The chuck spindle is made in two sections, so that the chuck itself merely floats on the top bearing instead of being directly connected to the drive. A floating coupling connects the two spindle sections. In the illustration, the table is shown in the grinding position; for loading, it is moved several feet to the left to facilitate the use of a crane.

After loading, the table is brought into the approximate grinding position by the rapid traverse, a limit switch automatically positioning the work in relation to the grinding wheel. The wheel then drops into the grinding position and the feeds engage. The wheel is brought into contact with the work by the same means that are employed on Heald automatic internal grinding machines. When the machine is equipped for production work, a dial indicator is provided for controlling the size of the work.

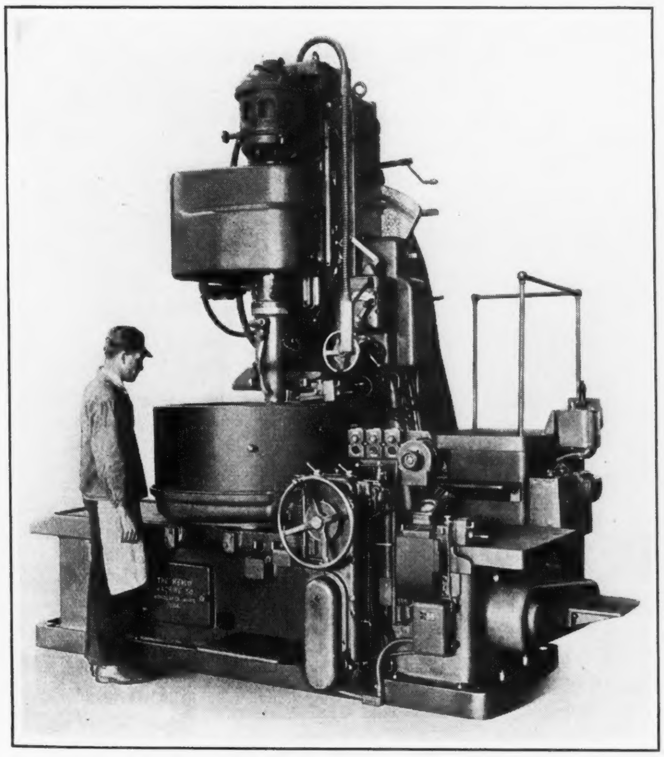
The table feed is obtained hydraulically. It can be made to operate at each end of the wheel-slide stroke or at one end only. The table feeds toward the left for grinding holes and toward the right for grinding outside surfaces. By using a cup-wheel, parts can also be face-ground at the same setting used for grinding the bore and outside. The 36-inch size of this machine weighs approximately 15 tons.

Cleveland All-Steel Forging Sizing Presses

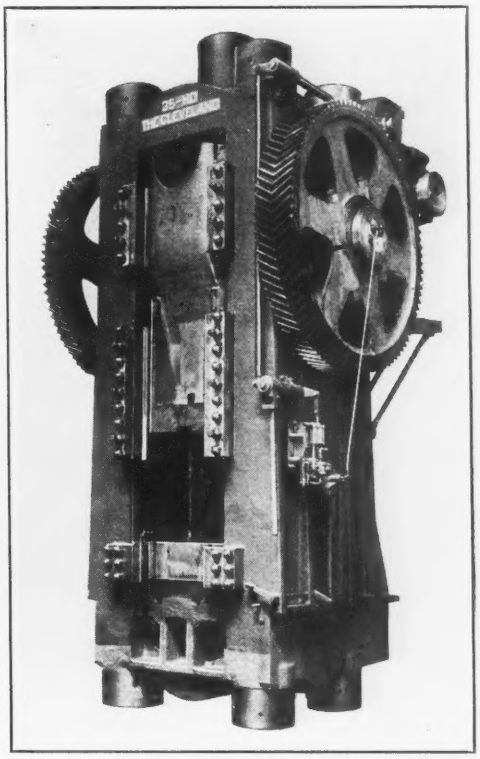
High-speed presses of all-steel construction are now being built by the Cleveland Punch & Shear Works Co., Cleveland, Ohio, for the sizing of forgings. The line consists of six standard machines, ranging in capacity from 200 to 2000 tons pressure. The illustration shows a press of 1800 tons capacity. It has a speed of 35 strokes per minute, the stroke being 12 inches. The crankshaft frame bearings are 17 1/2 inches in diameter, and the crankpins, 30 1/2 inches. All the drive shaft and intermediate shaft bearings are of the roller type. The bed and ram measure 60 inches from front to back, and the shut height of the die space is 29 inches. This machine weighs 315,000 pounds.

The presses of the new line are equipped with a hand-lever for "inching" the head when setting dies. There is a foot-treadle for starting or stopping the slide instantly at any point of its stroke. When the press is used intermittently, a positive automatic stop brings the head to rest at the top of each stroke. A safety device is incorporated, which is set to a predetermined tonnage to guard against danger, should the press be overloaded.

The slide is gibbed at both the top and the bottom to insure accuracy even when it is at the extreme end of its stroke. A



Heald Internal Grinding Machine of Vertical Construction to Accommodate Large Work



Cleveland All-steel Press Intended for Sizing Forgings

wedge adjustment is provided for the bolster, and this member can be adjusted in all directions for aligning the dies. If desired, automatic equipment can be supplied for carrying either hot or cold material to the dies.

Presses of this type are used for sizing automobile front axles, differential ring gears, brake-drums, wheel flanges, and differential housings, as well as for other heavy bar and sheet-metal operations.

Automatic pressure lubrication is supplied to all principal bearings by a pump and reservoir located on the frame. The pump is driven by the crank-shaft. The amount of lubricant furnished to each bearing can be adjusted and the time period can be varied from seven to sixty minutes.

Important specifications of this press are as follows: Opening through frame, 72 inches; area of bed, 30 by 85 inches; opening in bed, 15 by 56 inches; shut height from bed to slide, with the stroke down and the adjustment up, 15 1/2 inches; length of stroke, 4 inches; number of strokes per minute, 35; and net weight, 30,000 pounds.

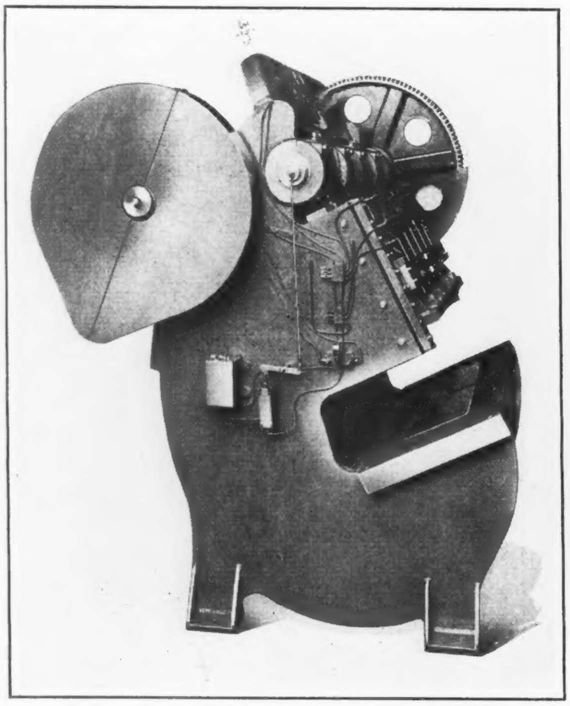
Henry & Wright Welded-Steel Overhanging Double-Crank Press

The latest addition to the line of welded-steel presses built by the Henry & Wright Mfg. Co., Hartford, Conn., is the No. 25 1/2 overhanging double-crank press here illustrated. This machine is inclined in a fixed position 25 degrees from the vertical, so that large blanks, such as automobile running boards and similar parts produced in compound dies, can slide by gravity to a conveyor at the rear of the machine.

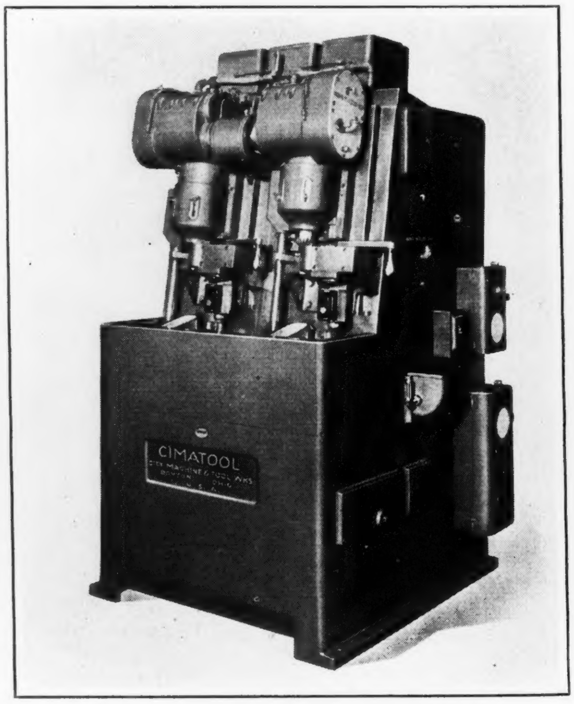
The frame, slide, and main gear are of welded steel construction. These parts are normalized and annealed after welding, so as to eliminate any stresses that may have been set up in either the rolling or welding process. Particular attention is called by the manufacturer to the fact that the throat of the frame is inclined with respect to the center line of the slide, and that it has a large fillet both at the top and bottom. Photo-elastic tests of this throat design show minimum stress concentration.

Cimatool Burring Machine

A special machine designed to remove the burrs produced in hobbing the bevel gear on automobile axle shafts was recently built by the City Machine & Tool Works, East Third and June Sts., Dayton, Ohio. This machine is of the two-spindle type. Each spindle operates independently of the other, thus permitting loading to be done at one station while an operation is going on at the other station. Although the production time is regulated by the feed and varies somewhat with the amount of material re-



Henry & Wright Double-crank Press of Welded Steel Construction



Machine Designed to Remove Burrs from End of Automobile Axle Shafts

moved, the machine is capable of a six-second cycle.

Four motors drive the various units. The operating spindles, cam feed mechanism, coolant and lubricating pumps, and self-oiling system are standard equipment. One of the minor features is an ingenious arrangement for clamping the work. The clamping handle is moved through but a short distance, yet it has a positive non-slipping action.

Conveyor Chain that Travels Around Curves

The Chain Belt Co., Milwaukee, Wis., has developed a conveyor chain that facilitates the installation of conveyors in plants built without consideration of present-day work-handling methods. Often, in planning a conveyor installation in such a plant, when a straight-line conveyor would be most logical, the engineers find that a pillar or a machine makes an installation of that type impossible. The illustration shows how conveyors made up of the new chain can take a snake-like course between walls, columns, and stationary equipment.

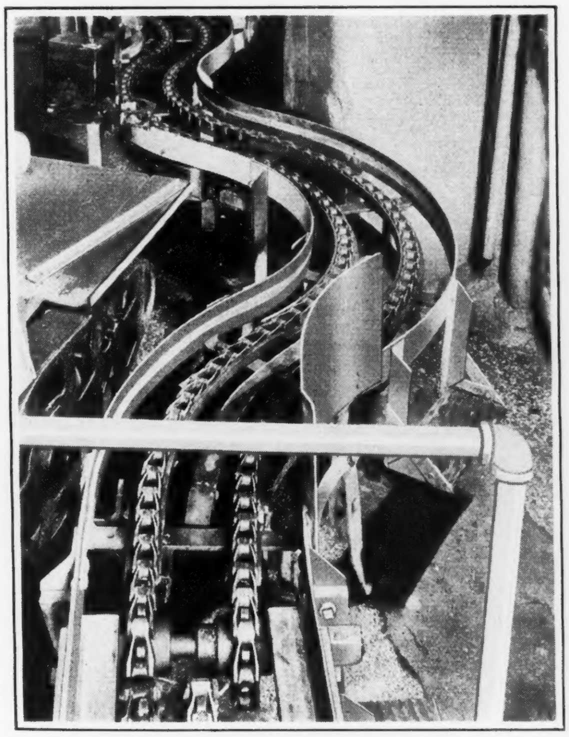
This new chain, which has been designated the "Rex No. 137," possesses a universal joint feature which gives it a high degree of flexibility, making it possible for the chain to carry work smoothly and positively around curves. The bushing fits into the link of the chain vertically rather than horizontally and the pin and bushing are free to turn within the link. This revolving action, in addition to the ample side-bar clearance provided, allows the chain to flex around corners. The chain can also be used for straight-run conveying, either horizontally or slightly inclined.

Magazine for Pratt & Whitney Full-Automatic Lathe

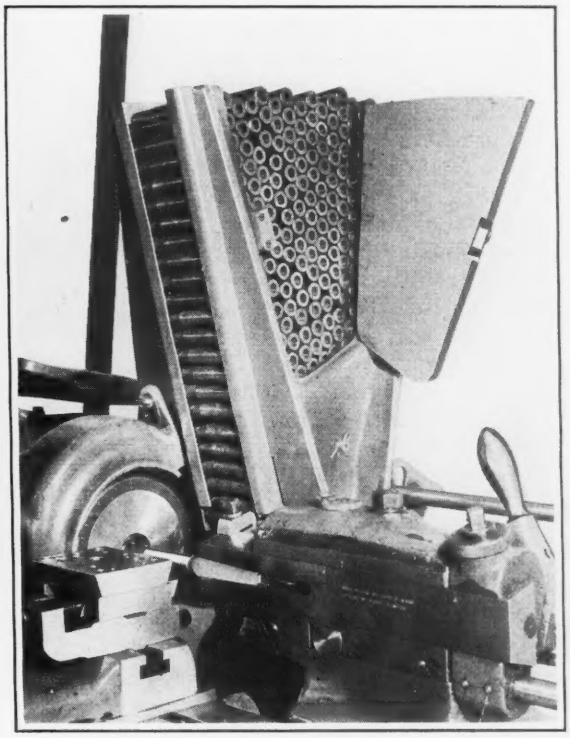
The magazine here illustrated was developed to greatly increase the loading capacity of the 1- by 18-inch full-automatic lathe made by the Pratt & Whitney Co., Hartford, Conn. As illustrated, this magazine is set up for handling cast-iron automobile valve-stem guides. Three hundred pieces comprise a full load. This represents about seventy-five minutes work, as the valve-stem guides are machined in fifteen seconds each.

The over-all length of these pieces is 3 13/16 inches, and they are turned to 11/16 inch in diameter ready for a centerless grinding operation. The turned length is 2 1/2 inches. The ends of the guides are also faced during the operation.

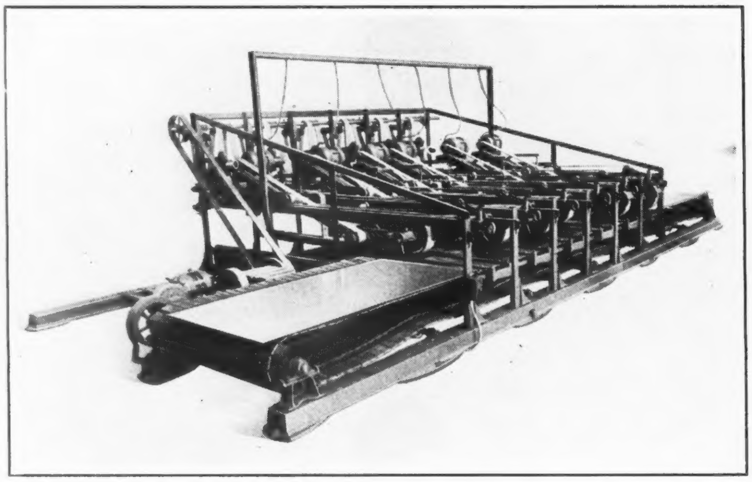
With this magazine, one operator can handle several more machines than with the small type of magazine that was previously available. The magazine has a hinged door on one side, which can be opened to facilitate loading. An agitating device on the bottom of the magazine prevents the jamming of work.



Chain Conveyor that Winds in and out between Walls, Pillars, and Machines



Magazine for P & W Full-automatic Lathe which Holds 300 Valve-stem Guides



Excelsior No. 28 Stainless Steel Polishing Machine

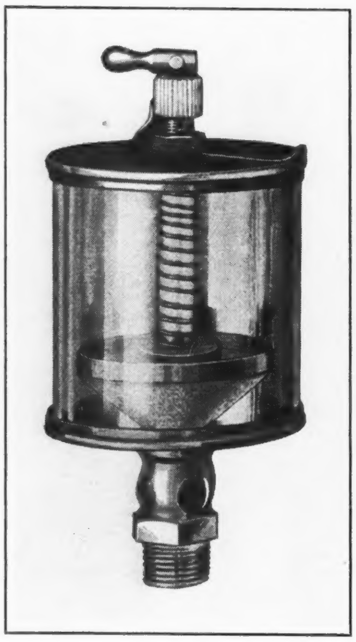
Excelsior Automatic Stainless Steel Polishing Machine

Stainless steel sheets up to 60 inches wide by 144 inches in length or longer are polished to a commercial finish in one continuous pass under the multiple number of polishing belts that comprise the machine here illustrated. This machine is a recent development of the Excelsior Tool & Machine Co., 30th to 32nd St., Ridge to Jefferson Ave., East St. Louis, Ill. Although the machine illustrated is equipped with six polishing belts, any number can be provided.

Sheets of stainless steel, placed end to end on the endless belt conveyor, pass under the roughing and finishing belts at a constant speed. The sheets are polished completely to the extreme edges. Shifting of the sheets is prevented by a hold-down arrangement consisting of rollers spaced equidistantly between the polishing belts.

The polishing belts are 7 inches wide by 8 feet long, and are endless. Each one operates over two end pulleys, the inside pulleys being driven direct by 10-horsepower, dustproof, ball-bearing motors. An intermediate idler pulley is located between each set of end pulleys for keeping the polishing belt in contact with the sheet. This is a self-adjusting feature that produces a uniform pressure over the entire working face of the polishing belt. This pressure is regulated by means of weights.

Any of the polishing belts can be removed when dull and replaced in two minutes without interfering with the operation of the remaining belts. A tightening device maintains the desired belt tension. The conveyor has a speed ratio of 2 to 1. The six-belt machine illustrated occupies a floor space of 38 by 18 feet and has a weight of approximately 32,000 pounds.



Conventional Oil-cup with Morrow Filter

Metal Polish in Powder Form

A metal polish in powder form that incorporates the necessary stabilizing and emulsifying agents to produce a stable suspension when the powder is mixed with water has been placed on the market by Foster D. Snell, Inc., 130 Clinton St., Brooklyn, N. Y. By mixing the powder in water, a non-inflammable polish is obtained, which complies with U. S. Government specifications. It is packed in paper or cardboard containers.

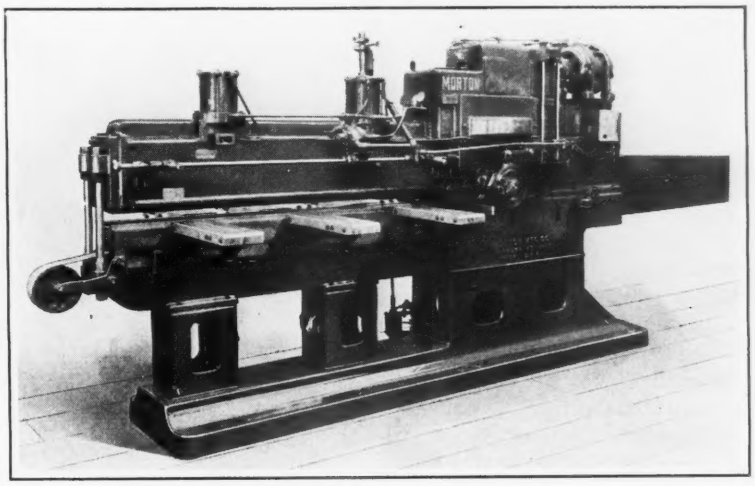
Morrow Oil-Cup Filters

An oil-cup with a filter to prevent dirt, sediment, or other foreign matter from entering a bearing from the cup is shown in the illustration. This filter is manufactured by the Howard B. Morrow Co., Mishawaka, Ind., and may be applied to practically all commercial oil-cups. Its use does not in any way change or retard the function of the oil-cup as originally made, but enables it to deliver filtered oil only.

All oil in the cup must pass in an upward direction to the inside of the cone, which may be seen in the illustration. This cone is made of an impregnated felt. From the inside of the cone, the oil passes through a central tube to the bearing being lubricated. The filter membrane is in a semi-inverted position, so that it is protected from all direct pollution by the coarser and heavier settlings from the oil. These are separated by gravity and deposited at points away from the surface of the filter. The roof of the filter element is provided with a shallow catch basin that also holds coarse settlings of foreign matter, while the finer dirt in the oil comes to rest in the bottom of the cup out of contact with the filter surface.

The features that keep the dirt from coming in contact with the filter cone tend to prolong the filter cleaning intervals.

Morton 72-Inch Draw-Cut Flash-Trimming Machine



Morton Flash-trimming Machine with a 72-inch Stroke

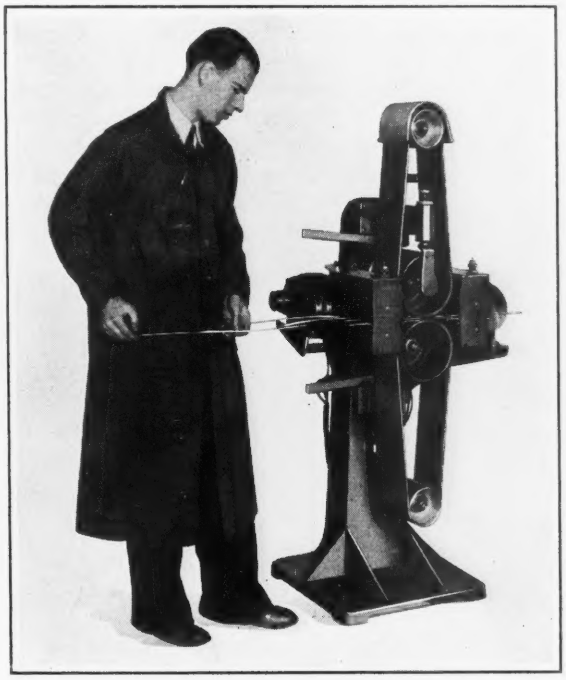
Sheets up to 72 inches wide can be handled by the machine here illustrated, which has been designed by the Morton Mfg. Co., Broadway and Hoyt St., Muskegon Heights, Mich., for removing the flash or upset produced in butt-welding sheets and plates. The machine can also be used for salvaging scrap and trimming new sheets of various widths.

This machine is built on the draw-cut principle and, except for size, follows the design of the 40-inch stroke machine described in July MACHINERY, page 858. Two rams trim both sides of a sheet in one operation. These rams are reciprocated by means of reversing clutches. Before reversal takes place, the upper ram is raised a distance of 2 inches, thus making possible easy removal of the work while the rams are returning to their outer positions. The rams carry multiple cutting tools which are quickly adjustable for height, and also rollers that precede the tools to straighten any unevenness in the work.

Clamping of the work for the trimming operation is accomplished by means of air cylinders which automatically compensate for any variations in the thickness of the sheet or plate being handled. There is also a special air device which automatically raises the work from the dies when aligning it for the trimming operation or when removing it after the operation has been performed. Machines of this type can be built with any length of stroke to suit requirements.

Porter-Cable Double-Belt Sander and Grinder

A sander and grinder with two abrasive belts running in opposite directions and power-driven feed-rolls for carrying the work between the belts is shown in the accompanying illustration. This equipment has been brought out by the Porter-Cable-Hutchinson Corporation, Syracuse, N. Y., for finishing two sides of a part simultaneously. The two large pulleys that drive the abrasive belts are covered with rubber, so as to serve as cushions beneath the belts. As the abrasive belts run in opposite directions, they neutralize any motion that might be transmitted by either belt to the work. The power-driven feed-rolls insure uniform feeding of the work pieces between the belts.



Porter-Cable Grinder and Sander with Two Belts and Power-driven Feed-rolls

A 1- or 1 1/2-horsepower motor, mounted on a hinged plate at the back of the machine, drives both of the abrasive-belt drum pulleys through a V-belt. The feed-rolls are driven by a 1/4-horsepower motor, which is also mounted on a hinged plate, so that the V-belt which transmits the power can be easily changed to any of the three pulley grooves for obtaining different rates of feed.

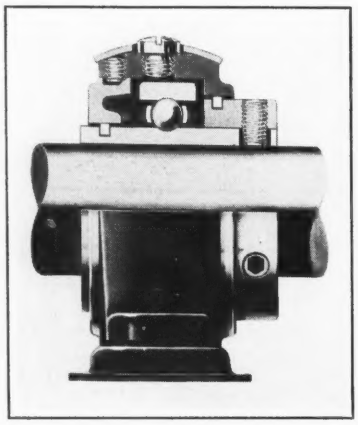
Work from 0 to 1/2 inch thick or from 1/2 to 1 inch thick and up to 6 inches wide can be handled. The minimum length of work is 12 inches. The net weight of this machine is about 700 pounds.

Van Keuren Light-Wave Micrometer

Light waves are used as a very sensitive indicator of contact and pressure in taking measurements with a bench micrometer recently developed by the Van Keuren Co., 12 Copeland St., Watertown, Mass. This instrument, as shown, has a measuring wheel graduated in units of 0.0001 inch, thus permitting readings of 0.00001 inch to be estimated. An optical flat is held in contact with a three-inch steel flat by spring pressure, and is connected through a tension rod to the arm that supports the micrometer. Thus, the slightest bending of the micrometer arm is detected by a movement of light-wave interference bands.

In use, the micrometer is turned to the zero position and adjusted until there is a movement of one, two, three, or more light-wave interference bands, depending upon the measuring pressure desired. A movable index is then set to zero and the measurement is taken with the same movement of interference bands as was used for the zero reading of the micrometer. While the instrument is operated and read as a micrometer, slight variations in size due to taper, out-of-roundness, or other causes can be determined by the movement of the light-wave bands.

This instrument is suitable for measuring paper, rubber, or soft materials, as well as gages, and for general shop use.



Pillow Block with Steel Housing and Piston-ring Grease Seal

Dodge Pillow Block with Formed-Steel Housing

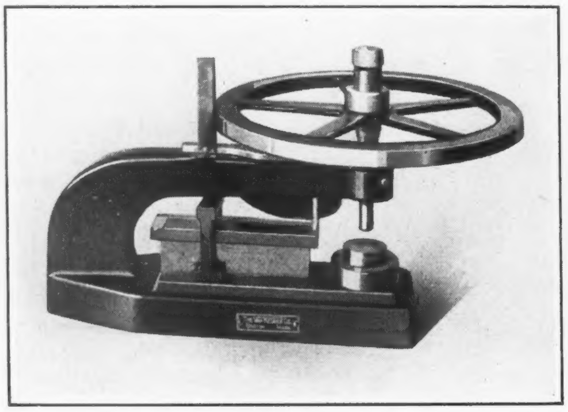
Pillow blocks with anti-friction bearings and a housing of two-piece formed-steel construction are being placed on the market by the Dodge Mfg. Corporation, Mishawaka, Ind., for a large variety of light-duty applications. They are intended for use on metal- and wood-working machinery, conveyors, fans, blowers, power transmission equipment, etc.

The split feature of the steel housing facilitates installation or removal of the anti-friction bearing. Another advantage of the steel housing is derived from the small over-all dimensions. The bearing is self-aligning through a ball-and-socket action obtained by making the outside of the inner housing spherical and the inside of the outer housing to match. Because the bearing is self-aligning, it is not necessary for the supporting surfaces to be absolutely in line, and machine frames need not be absolutely rigid. Both radial and thrust load capacities are provided.

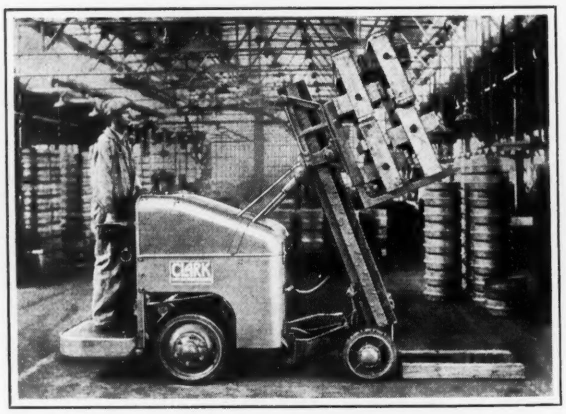
Leakage of lubricant from the bearing chamber and the entrance of dirt are prevented by the use of a piston-ring type of grease seal. These pillow blocks are made in various sizes to suit shafts of from 3/4 inch to 2 3/16 inches, inclusive. The "cartridge" which comprises the inner housing member and the anti-friction bearing is also available in the same sizes for many machinery applications.

Clark Tilting Lift Truck

A tilting lift truck which inserts long steel fingers under a load, tilts it back a maximum of 20 degrees, lifts it, carries it to its destination, and then tilts it forward 7 degrees for tiering safely at any height up to 50 inches has been designed by the Clark Tructractor Co., Battle Creek, Mich. The lifting and tilting mechanism of this truck is actuated hydraulically through an oil-pump. The motive power consists of a tractor-type gasoline engine. This truck is provided with a rear-wheel drive and steers with all four wheels. It is available in two- and three-ton sizes.



Bench Micrometer which Uses Light Waves to Indicate Contact Pressure



Clark Lift Truck which Tilts Backward in Loading and Forward in Tiering

Reliance Constant-Tension Regulator

Equipment intended for use with devices such as reels for strip steel, copper, or brass, and for other applications where it is necessary to wind or unwind material under a constant tension, has been developed by the Reliance Electric & Engineering Co., 1042-1090 Ivanhoe Road, Cleveland, Ohio. This constant-tension regulator eliminates the need for a slipping clutch.

The regulator armature has two windings, a "torque" winding and a "spring" winding. The torque winding is connected in series with the motor that drives the machine which winds or unwinds the material. The spring winding (so-called because it acts in a direction opposite to the torque winding, like a spring) receives its power from the main line.

When the current in each winding is the same, there is no movement of the regulator. If the current in the torque winding increases or decreases, however, there will be an increased or decreased torque in the motor that it is regulating. This causes a movement in the regulator, and the rheostat which is coupled to the regulator shaft will correct the voltage to the driving motor, so as to keep the torque constant. For unwinding material at a constant tension, the regulator is used in conjunction with a generator.

Die-sinker Available with Two Sets of Four Speeds Each

Binghamton Flexible-Shaft Die-Sinker

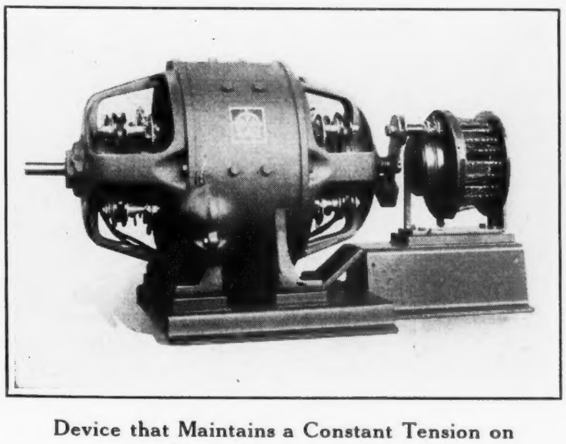
A flexible-shaft machine designed primarily for use in die, machine, and pattern shops for such operations as rotary filing, grinding, polishing, drilling, and sanding has been placed on the market by the Binghamton Flexible Shaft Co., 50 Maple Ave., Johnson City, N. Y. This equipment is manufactured in the bench model illustrated, and also in a pedestal model. The important feature is that the tool at the end of the flexible shaft can readily be presented to the work at any convenient angle. By mounting the motor and pulley unit on a combination ball-bearing swivel-and-yoke type of suspension, unusually long life of the flexible shaft is insured.

Two sets of speeds are obtainable with each model. One set ranges from 900 to 3800 revolutions per minute, and the other from 1800 to 7600 revolutions per minute.

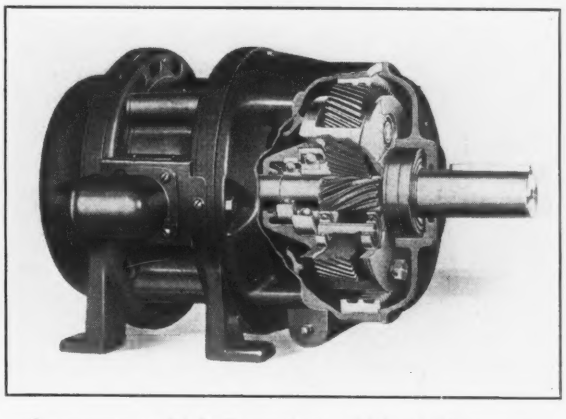
General Electric Motors

Three new lines of motors recently placed on the market by the General Electric Co., Schenectady, N. Y., include gear-motors of the design illustrated; splash-proof induction motors; and general-purpose direct-current motors. The gear-motors consist of a normal speed motor and a built-in helical planetary-gear speed reducer. This construction permits a wide choice of speeds on the output shaft and makes it possible to adapt the gear-motors to almost any type of low-speed drive.

Gear-motors are also available with special electrical characteristics, such as high starting torque with low starting current, normal starting torque with low starting current, varying speed, multi-speed, etc. They are also obtainable totally closed; totally enclosed and fan-cooled; and of Class 1, Group D construction for use in hazardous gas locations. Alternating-current gear-motors of polyphase, squirrel-cage, and wound-rotor types are available in ratings up to 75 horsepower, and up to 5 horsepower in the single-phase type. Direct-current gear-motors are available in ratings up to 7 1/2 horsepower.



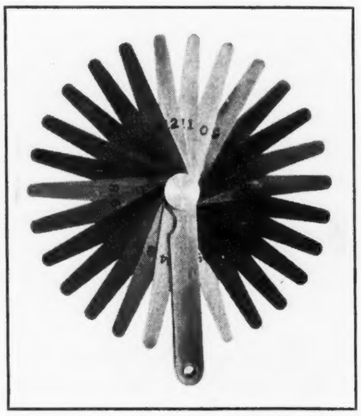
Device that Maintains a Constant Tension on Stock Wound on Reels



Gear-motor which Comprises a Helical Planetary-Gear Speed Reducer

The new line of splash-proof induction motors has been designed particularly for applications where open-motor operation is handicapped by splashing or dripping liquids. The top half of the end shields is made solid to exclude dripping water and liquids, while the bottom half is provided with ventilating openings to permit the entrance of cooling air. A baffle prevents the entrance of splashing water into windings, and the motor frame is protected from liquids by a one-piece cover.

The direct-current motors are so designed that many mechanical variations can be accomplished by using only a few different parts. For instance, different degrees of enclosure are obtainable in this way to suit various applications. New pulley end shields afford maximum protection to the motor windings.



Brown & Sharpe Thickness Gage with Twenty-six Blades

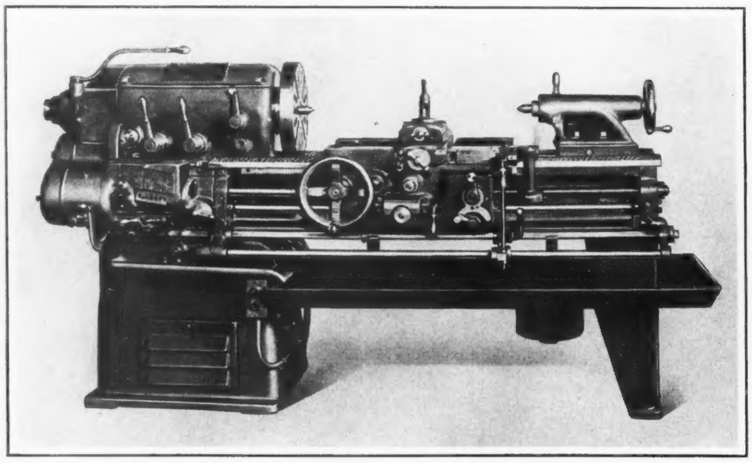
Reed-Prentice Sliding Gear Head Tool-Room Lathes

Eight- and sixteen-speed lathes of 14-, 16-, 18-, and 20-inch sizes are included in a new line of tool-room lathes being placed on the market by the Reed-Prentice Corporation, Worcester, Mass. Except for a new quick-change gear-box with lead-screw reverse mechanism, these machines follow the design of the lathes described in January, 1932, MACHINERY, page 378. The lead-screw reverse mechanism provides for reversing the carriage when feeding or threading without reversing the direction of spindle rotation.

The reverse lever is conveniently located at the right-hand side of the apron. Adjustable stops provide for automatically stopping the carriage when feeding or threading in either direction and at any predetermined point. The lead-screw nut remains engaged when the lead-screw is stopped or reversed, permitting ready catching of the thread in cutting threads of odd leads and metric pitches. A thread dial facilitates catching the threads of long screws when the carriage is run back by hand.

The quick-change gear-box provides forty-nine thread changes from 1 1/2 to 96 per inch and forty-nine feed changes from 0.0035 to 0.224 inch per spindle revolution. There is an auxiliary quadrant for any additional gears that may be required in cutting odd or metric threads and for feeds other than those obtainable through the gear-box.

The entire end-gear train and quick-change gear mechanism is mounted in anti-friction bearings. An oil-pan with a rolled edge and a cabinet leg for the tailstock can also be supplied.



Reed-Prentice Tool-room Lathe with Quick-change Gear-box Providing Lead-screw Reversal

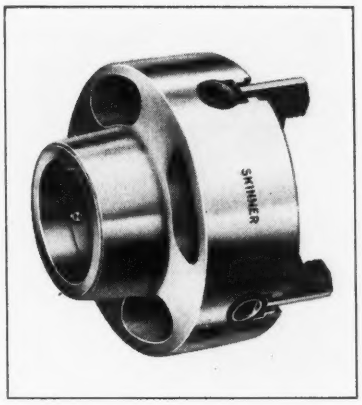
Brown & Sharpe Thickness Gages

Two new thickness gages, Nos. 645 and 647, have been added to the line of tools made by the Brown & Sharpe Mfg. Co., Providence, R. I. These gages have tapered blades, 3 inches long and 1/4 inch wide at the tip. The No. 645 gage has nine blades, varying in thickness from 0.0015 to 0.015 inch, inclusive, while the No. 647 gage has twenty-six blades, ranging in thickness from 0.0015 to 0.0025 inch.

Both gages are equipped with a device for clamping any or several of the blades in position for use. The blades can be used either singly or in combination. The addition of these two gages to the Brown & Sharpe line now makes available twelve different sizes and styles of thickness gages.

Cataract Bench Lathes with Integral-Mount Jaw Chucks

Bench lathes manufactured by Hardinge Bros., Inc., Elmira, N. Y., can now be equipped with integral-mount jaw chucks of the construction illustrated. It will be seen that means of mounting are incorporated in the chuck body itself. The advantages claimed for this construction include increased accuracy, reduced overhang, and the elimina-



Integral-mount Jaw Chuck Developed for Use on Cataract Bench Lathes

tion of common chuck mounting troubles.

The chucks are made by the Skinner Chuck Co., New Britain, Conn., and are available in universal and independent styles. After they have been assembled, they are mounted on cone-nose live spindles and the jaws are ground on their gripping surfaces.

Thermo-Tel Electric Temperature Signal

A temperature signal device which indicates the temperature by means of electric lights has been developed by the Uehling Instrument Co., 473 Getty Ave., Paterson, N. J. This device is intended to be used for temperatures up to 650 degrees F. When the temperature is within the limits for which the instrument is set, a white light is illuminated; when the temperature is above the maximum limit, a red light is illuminated; and when the temperature is below the minimum limit, all lights are out. Thus, a glance at the lights definitely tells whether the temperature is high, low, or within the desired limits.

The signaling lights may be located at any distance from the furnace and can be read at a distance of 200 feet or more. Unusual accuracy is claimed for this Thermo-Tel temperature signal.

H & G Non-Rotating Die-Head with Insert Chasers

A stationary die-head with insert chasers, intended for hand turret lathes and similar machines on which the die-head does not rotate, has been placed on the market by the Eastern Machine Screw Corporation, 21-41 Barclay St., New Haven, Conn. This head uses the same insert chasers as are used in the rotary head that was described in October, 1931, MACHINERY, page 149.

Two important advantages of insert chasers to the turret lathe operator are that the machine need never be idle for sharpening chasers, and when a new set of chasers must be inserted, the operator does not have to change the set-up. Furthermore, the chasers can be changed in less than two minutes. The chasers always project beyond the body the same amount, thus making the head especially suitable for shoulder or chucking work. The head comprises only four principal parts, the body, sleeve, cam carrier, and shank.

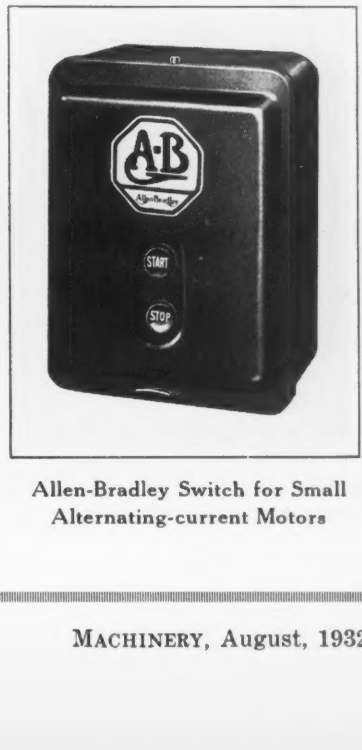
This die-head is of the pull-off type, the length of pull-off being sufficient to permit the operator to watch the head maintain its own lead. He does not need to control the lead. Bunting springs eliminate the need for a skillful start. The head is so designed that if the part being threaded should become loose in the collet or chuck, the head can be tripped by a slight blow on the handle. An adjustable work-stop may be fastened in the shank for tripping the head. This die-head is made in several sizes for threads from 3/16 to 3 inches in diameter, inclusive.

Die-head with Insert Chasers for Hand Turret Lathe

Allen-Bradley Hand-Operated Starting Switch

A compact manually operated switch that will start and stop small alternating-current motors and give overload protection has been developed by the Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis. This Bulletin 609 switch has two overload relays. Tripping of either relay opens the contactor and completely disconnects the motor from the line. Either relay, after tripping, can be reset without opening the switch cabinet.

This switch is made in two sizes. Size 1 will handle self-starting single-phase motors up to 1 horsepower, 110 volts, and up to 2 horsepower, 220 volts; or polyphase motors up to 2 horsepower, 220, 440, and 550 volts. The Size 2 switch is rated at 5 horsepower, 220 volts, and 7 1/2 horsepower, 440 and 550 volts, for two- and three-phase motors.

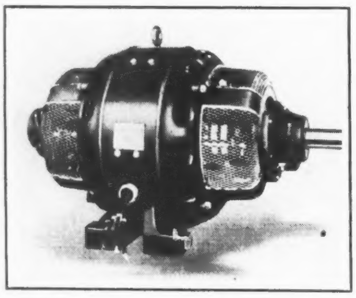


Allen-Bradley Switch for Small Alternating-current Motors

"Ideal" Self-Synchronizing Motors

Compact, self-exciting, self-synchronizing motors have been placed on the market by the Ideal Electric & Mfg. Co., Mansfield, Ohio. The exciter windings, direct-current commutators, etc., are integral with the motors. No field switches or synchronizing relays are necessary, the motors being started with simple hand-operated compensators in the same manner as ordinary induction motors.

These "Self-Syn" motors possess the ability to automatically re-synchronize themselves after they have been pulled out of step by a line-voltage dip or a momentary overload. The motors are available in all sizes from 5 to 100 horsepower, and with speeds of 900, 1200, and 1800 revolutions per minute.

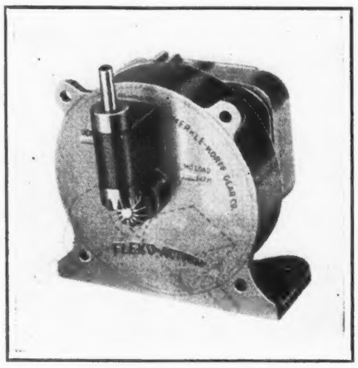


Synchronous Motor that is Self-exciting and Self-synchronizing

Merkle-Korff Speed Reducer with Integral Motor Drive

A small speed-reduction unit with an enclosed motor drive has been placed on the market by the Merkle-Korff Gear Co., 213 N. Morgan St., Chicago, Ill. This unit, which is shown in the accompanying illustration, has a wide range of application, due to its compactness and its adaptability to various conditions. The over-all dimensions are: Height, 3 3/8 inches; width, 3 1/8 inches; and depth, 2 3/8 inches.

The unit can be supplied for almost any speed required from the motor speed of 3000 revolutions per minute downward. It can be obtained for either clockwise or counter-clockwise rotation. Both horizontal and right-angle drives can be furnished. Right-angle drives are available with the output shaft in any position around the 360-degree circle. An induction motor of the shaded-pole type or a synchronous motor is provided. The gears run in grease, sealed in the gear housing to insure positive lubrication and quiet operation.



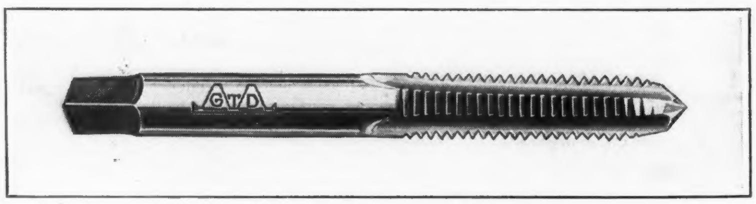
Compact Speed Reduction Unit with Built-in Motor Drive

Greenfield Stub Taps with Square-End Shanks

The stub taps manufactured by the Greenfield Tap & Die Corporation, Greenfield, Mass., are now made with a square on the end instead of with plain round shanks. This construction, which makes the stub taps now available for all automatic tapping machines, does not prevent their effective use in machines equipped with chucks or collets for the round-shank taps. Taps of the latter type can also be furnished when specified.

These stub taps are supplied in machine screw sizes and are designed primarily for tapping thin metals. They have a short thread section and taper flutes, a design which is said to give strength and rigidity that insure long life in tapping through holes.

The No. 1815 set of "Little Giant" screw extractors, also made by the Greenfield Tap & Die Corporation, is now available in a canvas roll, as well as in the ordinary wood-block container. The canvas roll is compact and can be easily carried in the pocket. This set of extractors contains the five most popular sizes, ranging from 1/16 to 7/16 inch.



Greenfield Stub Tap with Square-end Shank

* * *

Gasket Compound is Proof Against Hot Oil and Gasoline

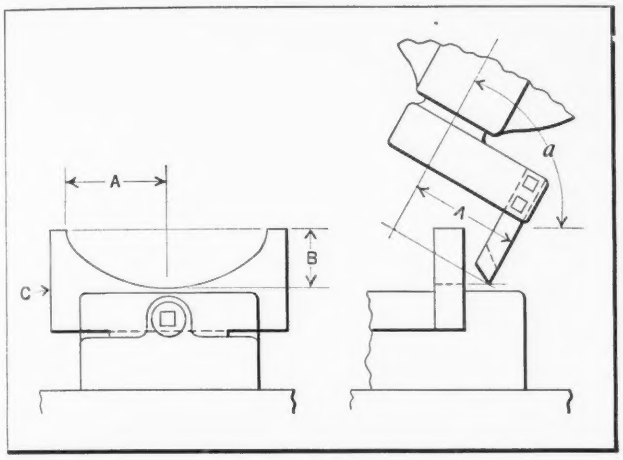
Gaskets made from a new substance that has been developed in the Research Laboratories of the General Electric Co., Schenectady, N. Y., are oilproof, even against hot oil, and are also proof against gasoline, kerosene, benzine, dilute acids, and dilute alkaline solutions. Oil-filled assemblies equipped with these gaskets have been operated in tests at from 210 to 230 degrees F. for a year without affecting the gaskets and without leakage.

This gasket compound is a brown, odorless, and sulphur-free alkyd resin material, for which the trade name Glyptal has been adopted. The compound is flexible and practically incompressible, and there has been no noticeable hardening or stiffening in outdoor exposure tests. At temperatures below zero, the compound is somewhat brittle.

Milling Elliptical Surfaces with a Fly Cutter

By R. V. RAYMOND

The accurate machining of a true elliptical surface is a problem with which the tool and die maker is frequently confronted. This job can be done on the milling machine in a very simple manner without the aid of expensive tools of special design. The only additional equipment required is a right-angle spindle attachment, a fly cutter, and an ordinary milling machine vise.



Milling Machine Set-up for Generating a True Elliptical Surface with a Fly Cutter

For example, a certain die required an elliptical opening and a punch of corresponding cross-section. To facilitate machining the elliptical surface, the die was made in two sections, one of which is shown at *C* in the illustration. After machining the flat surfaces, each section was drilled out to within 1/16 inch of the elliptical contour. One of the sections was then gripped in the jaws of the vise as indicated.

After setting the cutter to the required radial distance *A*, which equals one-half the major axis, the attachment was swung to an angle a determined by the formula $\text{Cos } a = B \div A$. With the cutter in its lowest position, the table was raised until the vertical distance from the cutter point to the top of the die was equal to one-half the minor axis or distance *B*. It is better, however, when extreme accuracy is required to increase this distance to $B + 0.005$ inch to allow for grinding the abutting joints of the die after hardening.

With the work and cutter positioned as described, the table feed was engaged, causing the point of the fly cutter to generate a true semi-elliptical surface. After both die sections were milled in this way, they were machine-filed for clearance, hardened, their abutting surfaces ground, and the sections assembled in the die-bolster.

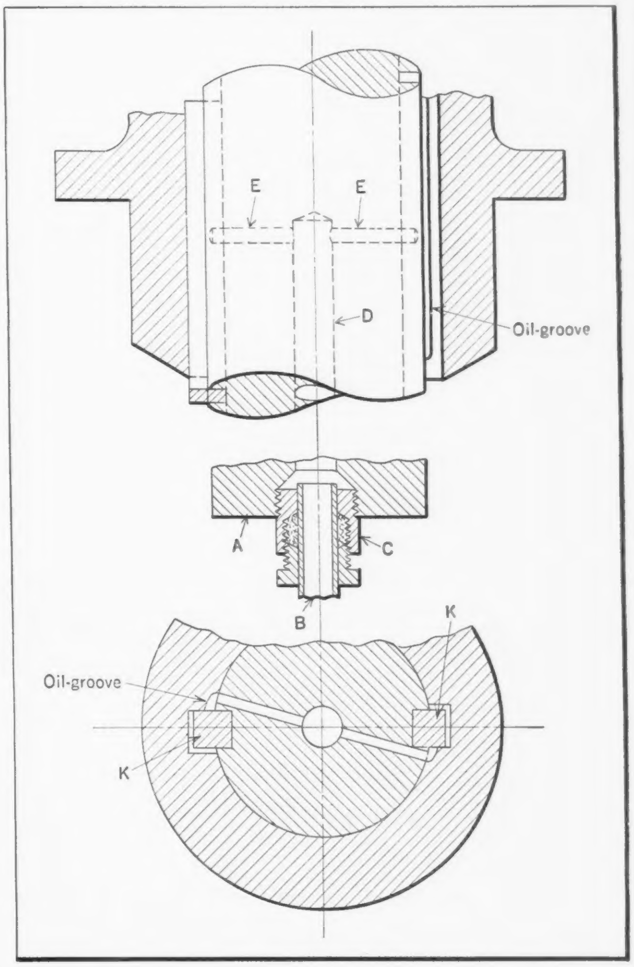
The same set-up was used for milling the elliptical surfaces of the punch, with the exception that a cutter of opposite hand was employed. It was necessary, of course, to make the punch also in two sections. Each section was gripped in the vise with its abutting surface downward. With the cutter in its highest position, the vertical distance from the cutting point to the abutting surface must be equal to $B + 0.005$ inch. The angle a remains unchanged.

When a number of duplicate sections are to be made, it is advisable to drill out the contour of one section and use it as a jig for drilling out the remaining sections.

Applying Lubricant Through Revolving Shafts

The practice of lubricating certain types of bearings through drilled passages in the shafts is quite general, and wherever it can be used is an excellent method. One builder of pressure fittings, the Cincinnati Ball Crank Co., Cincinnati, Ohio, makes a type of chuck that permits the application of a grease gun to a shaft that is in motion. This is intended for use on slow-moving shafts, as, for example, conveyor rollers. Oil lubricating systems such as are made by S. F. Bowser & Co., William W. Nugent & Co., and others have swiveling fittings that make it possible to connect the oil-line to a moving shaft.

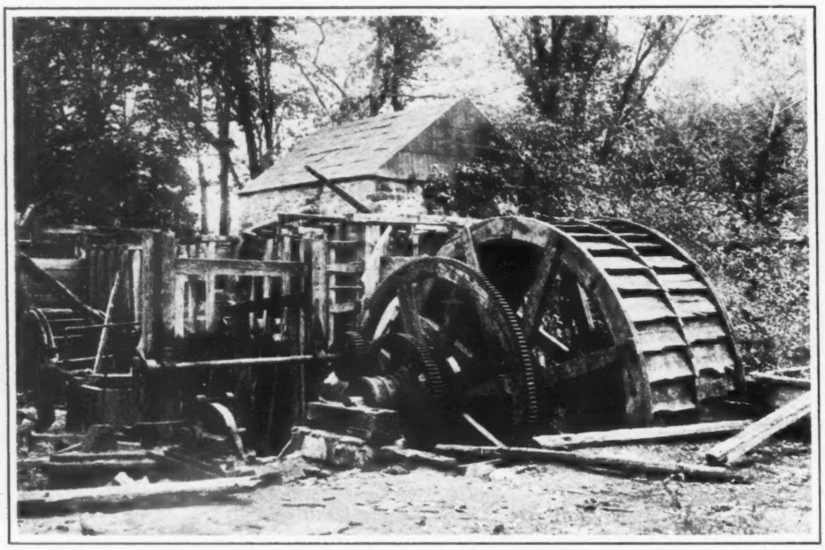
The idea of conducting oil from the center of a revolving shaft to sliding splines or keys, such as shown at *K* in the accompanying illustration, is theoretically correct, since it has the distinct advantage of working with instead of against centrifugal force, so that the natural flow of the oil is outward toward the surfaces to be lubricated. In this installation, the oil enters the oil-hole *D* in the revolving shaft *A* through the stationary pipe *B*, and is forced outward to the oil-grooves through the radial holes *E*. A suitable packing box *C* is provided to prevent leakage between pipe *B* and the revolving shaft *A*.



System Used to Conduct Oil from End of Rotating Shaft to Sliding Keys

Joseph T. Ryerson & Son Celebrate Ninetieth Anniversary

The firm of Joseph T. Ryerson & Son, Inc., is celebrating its ninetieth anniversary this year. It was in 1842 that Joseph Ryerson stepped off a lake steamer on the dock at Chicago, seeking his fortune in the great undeveloped Central West. His home had been in Philadelphia. Upon the death of one of the members of the firm by whom he had been employed, the business was discontinued and he found himself out of employment. He had heard little of Chicago, but a suggestion made to him by a firm of Pittsburgh iron manufacturers to establish himself in the business of selling steel in the new western town struck a responsive chord. The 900-mile journey from Philadelphia to Chicago required nine days of hard travel, by stage coach, boat, and rail. It was not an impressive city at which the traveller arrived, for Chicago, at that time, had barely six thousand inhabitants.



The Old Ryerson Forge in New Jersey where Some of the First Domestic Iron Used in America was Made

From the very first, however, Mr. Ryerson's venture proved successful, and from time to time he moved into larger quarters. The business of the pioneer-founder has been carried on throughout the last ninety years and developed by those who took over the work after him. In 1902 it was located on the present site at 16th and Rockwell Sts., Chicago, where the headquarters of the firm still remain. In 1914, the business was expanded by the addition of plants and warehouses in various other cities, beginning with New York and followed by St. Louis, Detroit, Buffalo, Cincinnati, Milwaukee, Boston, Cleveland, and Philadelphia.

The Ryerson name has been connected with the iron and steel industry of this country for about two centuries. The accompanying illustration shows a view of the old Ryerson forge in New Jersey where some of the first domestic iron used in the American colonies was made. It was to this locality that Joris Ryerson, eldest son of Martin Ryerson, who arrived in this country from Holland in 1646, came in 1708. The valuable mineral deposits discovered on his land were developed by his sons and nephews, who were among the first to smelt iron ore and produce forgings in this part of the country.

New Books and Publications

MODERN MATERIALS HANDLING. By Simeon J. Koshkin. 488 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $6.

This book is the outgrowth of a lecture course given by the author at Cornell University. It treats and analyzes modern methods of handling different kinds of materials, and deals with principles and considerations involved in a proper choice of the method of handling any kind of material. Examples and data relating to the design and performance of standard materials-handling equipment are given only in so far as it has been deemed advisable to illustrate the main points under discussion. The text is divided into twenty-six chapters dealing with the following equipment: Cranes; overhead transportation; industrial truck equipment; conveyor applications; package conveyors; speed reducers and photo-electric control of conveyors; belt conveyors; the skip hoist; chain, cable, and screw conveyors for bulk materials; bucket elevators and loaders; elevator conveyors; equipment for handling materials in bulk; and coal-handling and ashes-handling equipment.

DIRECTORY OF MANUFACTURERS OF STEEL CASTINGS AND HEAT-CORROSION RESISTANT ALLOY CASTINGS IN THE UNITED STATES AND CANADA, WITH STATISTICAL INFORMATION ON THE STEEL AND ALLOY FOUNDRY INDUSTRIES. 186 pages, 6 by 9 inches. Published by the Steel Founders' Society of America, Inc., Graybar Bldg., 420 Lexington Ave., New York City. Price, $10.

BIBLIOGRAPHY OF THE VIBRATION OF SHAFTS, VIBRATION MEASUREMENTS, AND THE DESIGN OF CRANKSHAFTS. By A. C. Bates and M. J. Zucrow. 109 pages, 6 by 9 inches. Published by Purdue University, Lafayette, Ind., as Research Bulletin No. 39 of the Engineering Experiment Station.

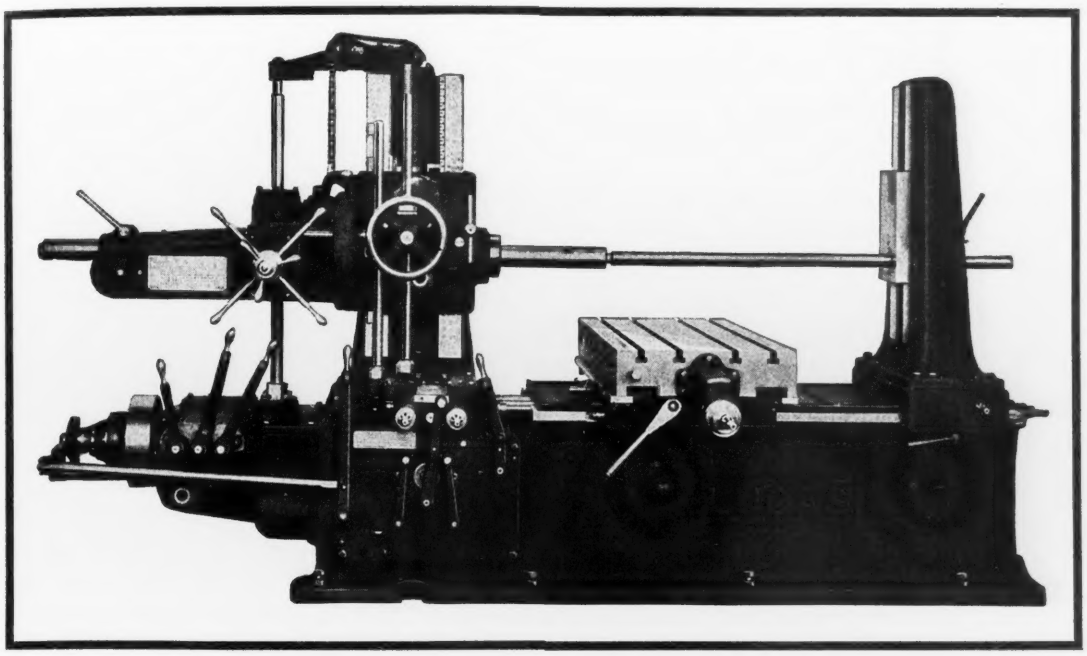
BEARING VALUE OF PIVOTS FOR SCALES. By Wilbur M. Wilson, Roy L. Moore, and Frank P. Thomas. 52 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 242 of the Engineering Experiment Station. Price, 30 cents.

STRENGTH OF LIGHT I-BEAMS. By Milo S. Ketchum and Jasper O. Draffin. 44 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 241 of the Engineering Experiment Station. Price, 25 cents.

SOME EXPERIMENTS ON OIL FILMS IN COMPLETE CYLINDRICAL BEARINGS. By Guido H. Marx. 110 pages, 7 by 10 inches. Published by the Stanford University Press, Stanford University, Calif.

* * *

According to the *Economic Review of the Soviet Union*, new oil deposits have been located in the Ural Mountains which are considered to be the most important oil discovery in recent years. Professor Gubkin, one of the leading Soviet geologists states that the indications are that these deposits are among the richest in the world.



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The latest type LUCAS is that kind of machine. Consider the economy of its 3-purpose operation. Consider its unusual rigidity, which means accurate alignment and consequent perfection of parts produced. Consider its higher spindle speeds, anti-friction bearings, improved clamping, wider feed range, rapid power traverse to all motions—and many other improvements in design and materials which have but recently become available. Don't you think it well worth your while to thoroughly investigate the LUCAS?

Now is the time for action! When may our representative call?

THE LUCAS MACHINE TOOL COMPANY, Cleveland, O.

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. Andrews & George Co., Tokyo. Catmur Machine Tool Corp., Ltd., London, Eng. M. Kocian & G. Nedela, Prague. V. Lowener, Copenhagen, Oslo, Stockholm. Emanuele Mascherpa, Milan, Italy. R. S. Stokvis & Zonen, Rotterdam, Paris.

MEN IN THE INDUSTRY

WALLACE T. MONTAGUE, who has been connected with the Norton Co., Worcester, Mass., for twenty years, has been made director of sales of the abrasive products division. H. K. CLARK, formerly manager of the Chicago branch, has become director of sales of the grinding wheel division. Mr. Clark's headquarters will be at Worcester, but much of his time will be devoted to field supervision. W. E. SHUMWAY, district manager at Hartford, Conn., has been made manager of the Chicago branch of the grinding wheel division. His former work in Connecticut will be carried on by C. A. NIERENDORF and R. W. PRICE, who have been associated with him at Hartford. WILLIAM PETTIGREW, formerly with the Research Laboratories, has joined the abrasive grain division as sales engineer.

ARTHUR NEWELL TALBOT, professor emeritus at the University of Illinois, was recently awarded the Lamme Medal at the fortieth annual meeting of the Society for the Promotion of Engineering Education. This award is bestowed annually in accordance with the provisions of the will of the late Benjamin G. Lamme, who was chief engineer of the Westinghouse Electric & Mfg. Co. In his will, he provided for a medal to "a chosen technical teacher for accomplishment in technical training or actual advancement in the art of technical training." In addition to his educational interests, Professor Talbot is prominently identified with several engineering societies.

CHARLES C. CLUFF, manager of sales of the New York district of the Carnegie Steel Co., Pittsburgh, Pa., with headquarters in New York City, has retired after more than half a century in the steel business and will be succeeded by JAMES R. MILLS, formerly manager of sales at Cleveland, Ohio. Mr. Mills has been with the Carnegie Steel Co. since 1898. FRANCIS C. HARDIE succeeds Mr. Mills as manager of sales at Cleveland. Mr. Hardie was formerly assistant manager of sales of the Illinois Steel Co. at Chicago.

A. L. BECHTEL, for many years vice-president and chief engineer of the Cleveland Punch & Shear Works, has established the A. L. Bechtel Machinery Co., 2848 Woodbury Road, Shaker Heights, Cleveland, Ohio. This company has been appointed exclusive agent in the Cleveland territory for the Bryant Machinery & Engineering Co., 400 W. Madison St., Chicago, Ill., and will handle the various lines of machine tools distributed by the Bryant organization.

ARTHUR MALLETT, formerly chief engineer of the Thomson-Gibb Electric Welding Co., Bay City, Mich., has joined the engineering staff of the Federal Machine & Welder Co., Warren, Ohio. CLYDE COATES, formerly designing engineer with the Taylor-Winfield Corporation, Warren, Ohio, has also joined the engineering staff of the company. The Federal Machine & Welder Co. announces that there is considerable activity in the sale of electrical resistance welding equipment.

CHESTER H. DU CLOE has been appointed a member of the staff of Schucht-Mier-Robertson, Inc., consulting engineers, Milwaukee, Wis. Mr. Du Cloe's work will consist principally of conducting analytical studies of the marketing and advertising problems of manufacturers. Mr. Du Cloe was with the J. Walter Thompson Co. for four years, and was previously with the Trade Press Publishing Co., of Milwaukee.

H. C. RAMSEY, vice-president in charge of international business of the Worthington Pump & Machinery Corporation, Harrison, N. J., sailed for Europe on the *Majestic* July 8. Mr. Ramsey will spend ten weeks in the British Isles and on the Continent, making a study of conditions and visiting Worthington's manufacturing and sales organizations in England, France, Germany, Spain, and other countries.

JOHN W. GOETZ, for twelve years assistant to the president of the National Industrial Conference Board, has been appointed managing director of the American Management Association to succeed W. J. DONALD, who resigned recently to become a partner of James O. McKinsey & Co. of New York and Chicago, management engineers and accountants.

MARTIN H. KIDDER, for several years with the publicity department of the Link-Belt Co., has recently established a press service with headquarters at 12238 Normal Ave., Chicago, Ill. Mr. Kidder will represent a few non-competing organizations in handling information suitable for publication in the technical press.

E. F. SELLS has been appointed manager of the Washington, D. C., office of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., to fill the vacancy caused by the death of Mr. B. H. Hamilton. Mr. Sells has been associated with the company since 1911.

Obituaries

GEORGE H. WHITTINGHAM, chairman of the board and chief engineer of the Monitor Controller Co., Baltimore, Md., died on June 4. Mr. Whittingham was the inventor of the automatic motor starter. His active creative work in the electrical field began before he applied for his first patent in 1888, and continued until his death.

He was born in New Castle, Del., March 23, 1867, and was educated at St. James College, Hagerstown, Md. When he left school, he became connected with the Sprague Electric Works of New York City, and was there for a short time, after which he went to Baltimore with the Baxter Motor Works. It was about that time that he applied for his first patent on an automatic motor starter.

During the fall of 1888 and spring of 1889, he organized the Automatic Switch Co. of Baltimore, for the manufacture and sale of automatic switches and motor starters of his invention. In 1904, he sold out his interest in the Automatic Switch Co. and returned to Baltimore, where, together with William C. O'Brien, he incorporated the Monitor Mfg. Co., which later developed into the present Monitor Controller Co.

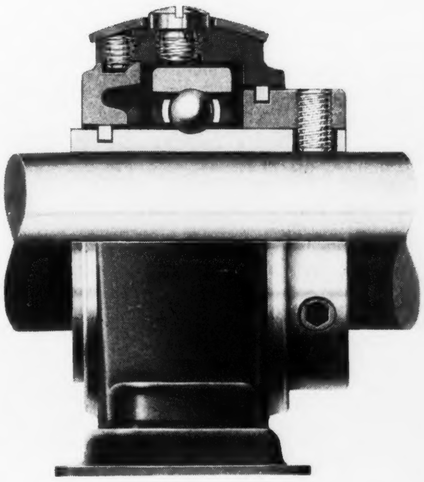
JAMES BARRETT, a member of the sales staff of the Worthington Pump & Machinery Corporation, Harrison, N. J., died on June 22, at the Columbia Presbyterian Medical Center in New York, after a short illness. Mr. Barrett was born in Canada October 14, 1866. He had been connected with the Worthington Pump & Machinery Corporation in various capacities for forty years, and had planned the pumping equipment for many of the important buildings in New York.

ROY C. BLANCHARD, production engineer of the Grinding Machine Division of the Norton Co., Worcester, Mass., died on June 29, following an operation, at the age of forty. Mr. Blanchard was a graduate of the Worcester Polytechnic Institute. He had been associated with the Norton Co. for sixteen years.

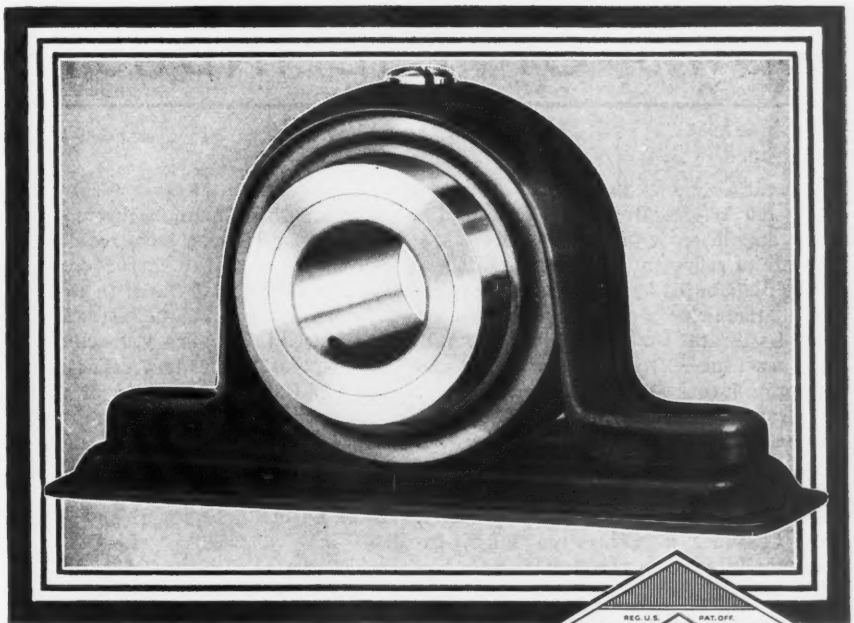
WILLIAM ROWAN, JR., for many years secretary and treasurer of the Morton Mfg. Co., Muskegon Heights, Mich., died on June 14.

HARRY F. OBERHELMAN, president of the Eastern Machinery Co., Cincinnati, Ohio, died on June 15.

HARRY P. USHER, president of the Smith Booth Usher Co., Los Angeles, Calif., died on June 7.



Cross sectional view of Dodge Type "DH-1" Ball Bearing Pillow Block showing details of construction



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You will find All of the features you want in this Pillow Block·

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IF YOU are now using babbitted bearings because you have not been able to buy an anti-friction bearing with all of the features it should have at a price that would not seriously affect your costs, you need do so no longer. You can incorporate Dodge Type "DH-1" Pillow Blocks (with Hoover Ball Bearings) in your product at a price you can afford to pay and with full assurance that you are giving the user every desirable and necessary feature that an anti-friction bearing of the light duty type should have.

This new Dodge bearing is fully self-aligning—it offers full radial and thrust capacity and also provides for expansion. The grease seals used are of the piston ring type providing positive protection against leakage of lubricant or admission of dirt. They are metal and will last forever. The bearing is factory adjusted and very easy to install. The formed steel housing is exceptionally strong and rigid. It is lighter than cast iron and has smaller overall dimensions. It is split, which is an additional feature of convenience.

The Dodge Type "DH-1" Pillow Block will add to the appearance and salability of your product and will give your customer added value and service. It is backed by the engineering and manufacturing experience of an organization of bearing mounting specialists and the world-wide reputation of Dodge for quality bearing units.

Send for our new Bulletin A-117 which gives full information.

DODGE MANUFACTURING CORPORATION, MISHAWAKA, INDIANA

REG. U.S. PAT. OFF.
DODGE
MISHAWAKA

NEWS OF THE INDUSTRY

Bryant Machinery & Engineering Co., 400 W. Madison St., Chicago, Ill., has appointed a number of exclusive agents to represent the lines of machine tools distributed by the Bryant organization, including Ohio shapers, planers, and horizontal boring, drilling, and milling machines; Dreses radial drills and monitor lathes; Boye & Emmes lathes; Cleereman upright drills; and Thompson grinders. D. E. Dony, 1115 Bay St., Rochester, N. Y., will represent the Bryant Machinery & Engineering Co. in the Rochester territory; G. A. Richey, 609 Chamber of Commerce Bldg., Indianapolis, Ind., in the Indianapolis territory; and Thomas M. Rees, 18 Fancourt St., Pittsburgh, Pa., in the Pittsburgh territory.

Tolhurst Machine Works, Inc., Troy, N. Y., specialists in centrifugal extractors, announce that they have purchased the Sweet & Doyle Foundry & Machine Co., of Green Island, Troy, N. Y. The latter company has specialized for the last thirty years in general machine shop work, gray iron castings, machine molded castings, pattern work, and experimental engineering development work. Perry Holder, manager and vice-president of the Tolhurst Machine Works, will supervise the combined companies, which will be located at Green Island, Troy, N. Y.

Thomas Prosser & Son, 15 Gold St., New York City, American representatives of Fried. Krupp A. G., Essen, Germany, announce a general price reduction of all Widia cemented-carbide tools and tips. This reduction became effective July 1. The reductions run from 10 to 40 per cent on various tools, depending primarily on the size of Widia tip used. Thomas Prosser & Son are also inaugurating a new service—that of supplying "milled and brazed" tools. These tools are furnished brazed complete, ready for grinding, which can easily be done by the customer.

Norton Co., Worcester, Mass., has acquired the entire common stock of the Pike Mfg. Co., Pike, N. H. The new unit will be incorporated under the name of Norton Pike Co. The main office of the new company will be located at Worcester, but the executive offices will be continued at Pike and manufacturing operations will be conducted at Pike and Littleton, N. H. The officers of the new corporation are: President, Herbert E. Smith; vice-president, W. LaCoste Neilson; treasurer, George N. Jeppson; and secretary, Clifford S. Anderson.

Garrison Machine Works, Inc., Dayton, Ohio, manufacturers of gear chucks of all kinds, have removed their office and factory to larger quarters in the Norwood Power Bldg. in Dayton. In this connection, it is of interest to note that it was twenty-five years ago, during the depression of 1907, that the late Orlando Garrison, founder of the firm, moved into larger quarters. Today his sons have taken advantage of present conditions to secure better manufacturing facilities, in order to be ready for increased business when the tide turns.

American Shim Steel Co., 1304 Fifth Ave., New Kensington, Pa., has been organized for the purpose of manufacturing and distributing shim steel to railroads, machinery builders, etc. The president of the company is C. Thomas Best, who, for the last five years, has been purchasing agent for one of the leading steel companies in the Pittsburgh district. The company is now in a position to furnish all sizes of shim steel, and will carry a complete line of standard sizes in stock.

Worthington Pump & Machinery Corporation, with executive offices at 2 Park Ave., New York City, and general offices at the Harrison, N. J., Works of the company, announces the transfer and consolidation of the designing, engineering, and manufacturing activities formerly carried on at the Cincinnati, Ohio, Works with those of the corporation's manufacturing plant at Buffalo, N. Y. This change in no way affects the Worthington's Cincinnati district sales office, which remains in that city.

Ruthman Machinery Co., Cincinnati, Ohio, has appointed the following companies distributors of Gusher ball-bearing pumps: Triplex Machine Tool Corporation, 50 Church St., New York City, is representative in eastern New York and the New England states; Goggin & Mills, 407 S. Dearborn St., Chicago, Ill., will act as representative in the Chicago territory.

Carboloy Company, Inc., 2481 E. Grand Blvd., Detroit, Mich., announces a reduction in the price of Carboloy cemented carbide. This reduction became effective July 1. The new price list, together with a 52-page handbook and catalogue, may be obtained upon request. The handbook contains information on Carboloy tool design, application, and maintenance.

Schucht-Mier-Robertson, Inc., Milwaukee, Wis., consulting engineers, have established as a separate department a new patent division to serve firms that do not require an entire department of this kind of their own. The patent division is also in a position to supplement the facilities of larger concerns who themselves have patent departments.

Foster Wheeler Corporation, New York City, manufacturer of power plant, marine, oil refinery, and gasoline plant equipment, has appointed the Consolidated Steel Corporation, Ltd., Los Angeles, Calif., exclusive sales and manufacturing representative for Foster Wheeler products on the Pacific Coast.

Columbus-McKinnon Chain Corporation announces the removal of their fire welding operations from Columbus, Ohio, to Tonawanda, N. Y. The Tonawanda plant is completely equipped to manufacture all sizes and grades of fire-welded chain, formerly made in Columbus.

Holo-Krome Screw Corporation, Hartford, Conn., manufacturer of hollow-head cap and safety set-screws and pipe plugs, announces that the factory and main office of the company were moved, on July 1, to Bristol, Conn.

Allen-Bradley Co., Milwaukee, Wis., manufacturer of electric motor control and radio accessories, has opened an export office at 15 Laight St., New York City, with Arthur Rocke as export manager.

Coming Events

October 3-7—National Metal Congress, Buffalo, N. Y., sponsored by the American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio, with the cooperation of the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Welding Society, and the Wire Association.

October 3-8—Fourteenth annual National Metal Exposition to be held in the 174th Regiment Armory, Buffalo, N. Y. W. H. Eisenman, secretary, American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio.

December 5-10—Tenth National Exposition of Power and Mechanical Engineering at Grand Central Palace, New York City.

* * *

A symposium of "The Physical Chemistry of Metals" will be held by the Division of Physical and Inorganic Chemistry of the American Chemical Society at the Society's eighty-fourth meeting at Denver, Colo., August 22 to 26. A number of papers on the chemistry of metals will be presented.

LELAND-GIFFORD

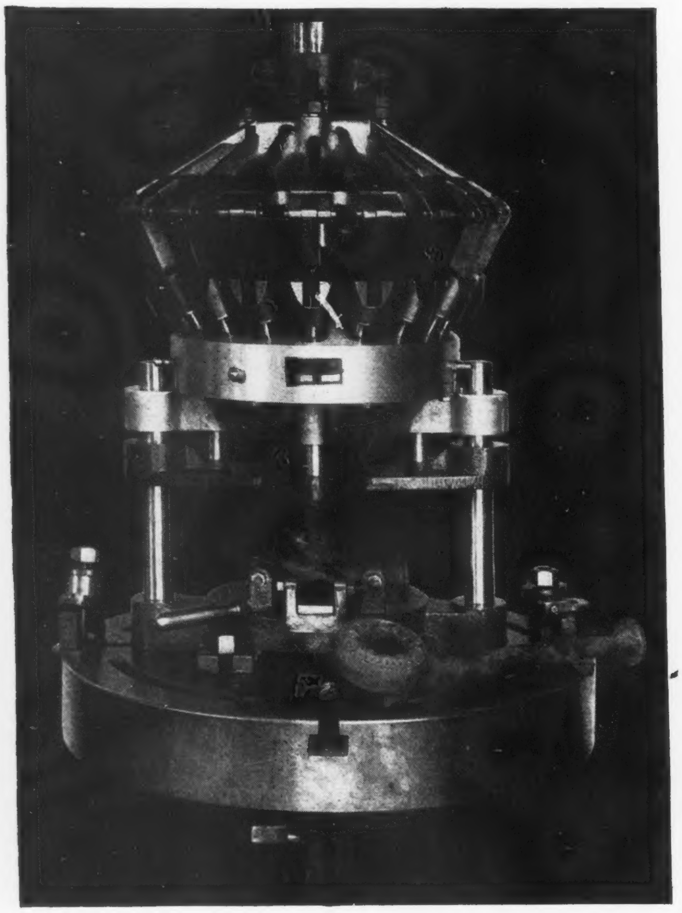
Unit-Cycle

10 operations
1000 per hour

HYDRAULIC FEED TO DRILLING UNITS. AUTOMATIC HYDRAULIC INDEXING OF WORK TABLE. AUTOMATIC CLAMPING AND EJECTING LEAD SCREW TAPPING.

LELAND-GIFFORD COMPANY, WORCESTER, MASSACHUSETTS

BOSTON CHICAGO CLEVELAND DETROIT NEW YORK PITTSBURGH ROCHESTER

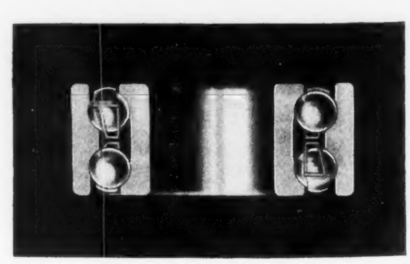


Drilling experts choose New Departures

The United States Drill Head Company of Cincinnati have specialized, for many years, in the business of reducing drilling costs. Thousands of New Departure Ball Bearings have gone into units built by them. Shown above is their answer to a gas-stove builder, who came to them with a peculiar drilling problem. Eighteen New Departures of the Double Row type, carry the thrust of every drill. No other anti-friction bearing offers such a compact and simple mounting. The Double Row ensures accuracy, speed ability, rigidity and freedom from wear and care. Take a tip from experts and use this New Departure Ball Bearing wherever thrust is heavy and continuous. The New Departure Mfg. Company, Bristol, Connecticut.

NEW DEPARTURE

BALL BEARINGS



1912

YOU CAN'T GO WRONG WITH A LODGE

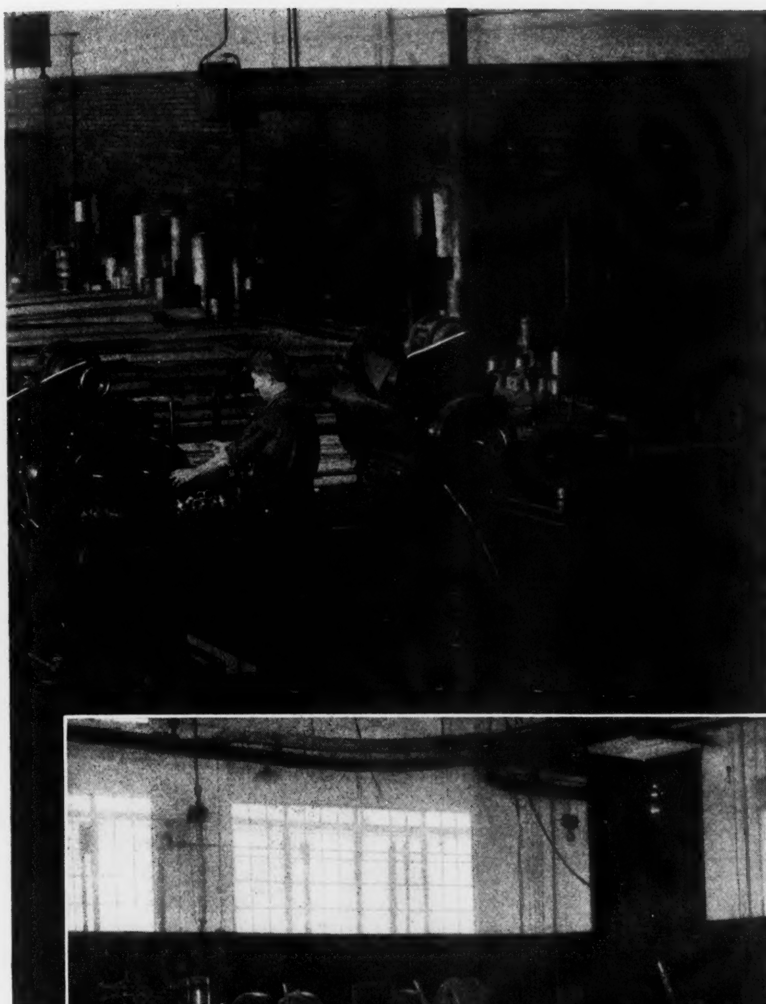
THE 14 INCH TOOL ROOM LATHE . . . .

CONFIDENCE ★ ★ ★

in the FUTURE and in LANDIS Threading Equipment

The layout and equipment of the new Crane Company shop would be an interesting story of modern pipe fabrication at any time. Now it is more than that, it is a sign that one of the largest and most progressive companies in an important field has sufficient confidence in the future of industry to go forward consistently in the path of development outlined by their years of experience in good times and bad.

The selection of Landis equipment is particularly significant at this time when methods, standards and costs come in for closer scrutiny than ever before. Crane products set world standards for quality in the important field of sanitary equipment. Landis machines are in operation in this new Crane shop for the simple and all important reason that Landis Threaded Pipe meets their exacting requirements both for quality and costs.



LANDIS REG. U.S. TRADE-MARK PAT. OFF.

These pictures show the new pipe shop of the Crane Company at Long Island City, N. Y., undoubtedly, one of the best equipped pipe shops in the country, or in the world for that matter.

The machines are Landis Pipe Threading and Cutting Machines and Landis Pipe and Nipple Threading Machines covering a range of pipe sizes from 1/8" to 20" inclusive.

Consistent confidence is now and always has been necessary to any form of progress. Landis leadership in the field of threading equipment has been earned by unremitting effort. Our story is one of constant improvement in threading methods and equipment that justifies the confidence of critical producers of pipes, bolts and other threaded parts.

• THE LANDIS LINE •

The Landis Line made in the world's largest plant devoted exclusively to the production of threading equipment.

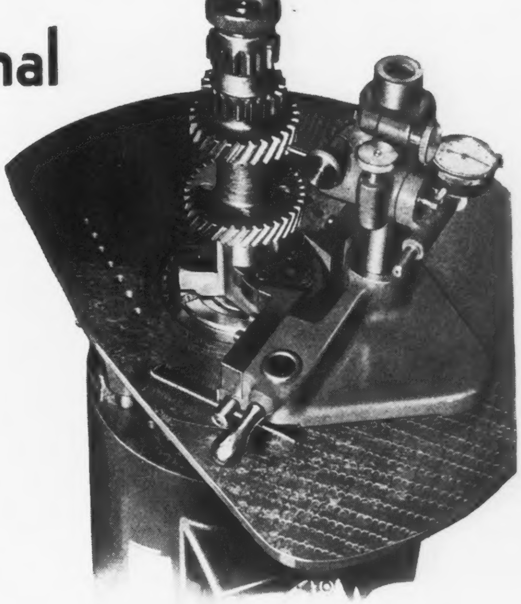
- LANDMACO Threading Machines
- LANDEX Head for Automatic Screw Machines
- LANDMATIC Heads for Turret Lathes and Screw Machines
- LANCO Heads for Automatic, Semi-Automatic and Hand Operated Threading Machines
- Threading Machines
- Bolt Factory Threaders
- Automatic Forming and Threading Machines
- Pipe Threading and Cutting Machines
- Pipe and Nipple Threading Machines
- Roller Pipe Cutters
- Stationary Pipe Die Heads
- Victor Collapsible and Adjustable Taps

LANDIS MACHINE CO., Inc.
Waynesboro, Pa.

DETROIT: 5928 Second Blvd.
CLEVELAND: 504-505 Marshall Bldg.
Agents in all Principal Cities of the World.

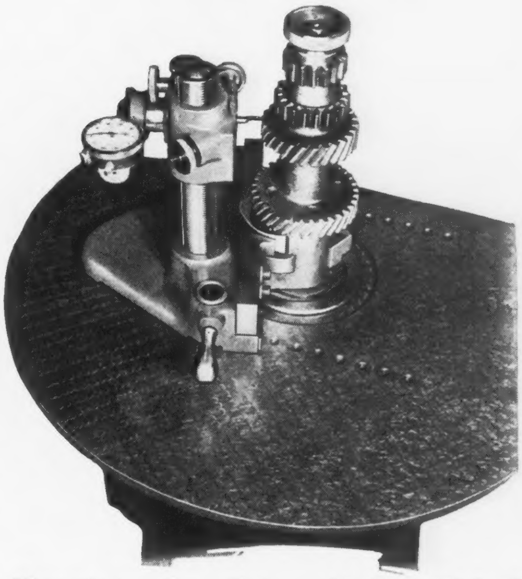
MEASURING MACHINE

Incorporating Many Original and Unusual Features



Measuring involute tooth profile.

Here is a new gear measuring machine which completely fulfills modern manufacturing demands. It is simple in construction and easy to operate—furthermore, it is possible to duplicate measurements to one-ten thousandth of an inch and less with comparative ease. It has been designed for every-day shop use—not a delicate laboratory product, yet capable of meeting every demand from the standpoint of accuracy and duplication of measurements. A feature of noteworthy interest is the ease and rapidity with which it can be adapted from one operation to another. Space does not permit a complete detailed description. Our representative in your locality will welcome the opportunity to explain and demonstrate the many advantages of this modern gear inspection machine. Write: The Fellows Gear Shaper Company, 78 River Street, Springfield, Vt. (616 Fisher Building, Detroit, Michigan)



Measuring tooth profile in combination with lead.

FELLOWS
GEAR SHAPER
METHODS

WHY

are we so emphatic in our statements of the accuracy of the J&L Tangent Die

?

HOW

can we positively guarantee a long life for chasers and an accuracy in form and lead up to the last sharpening grind

?

JONES & LAMSON

SPRINGFIELD,

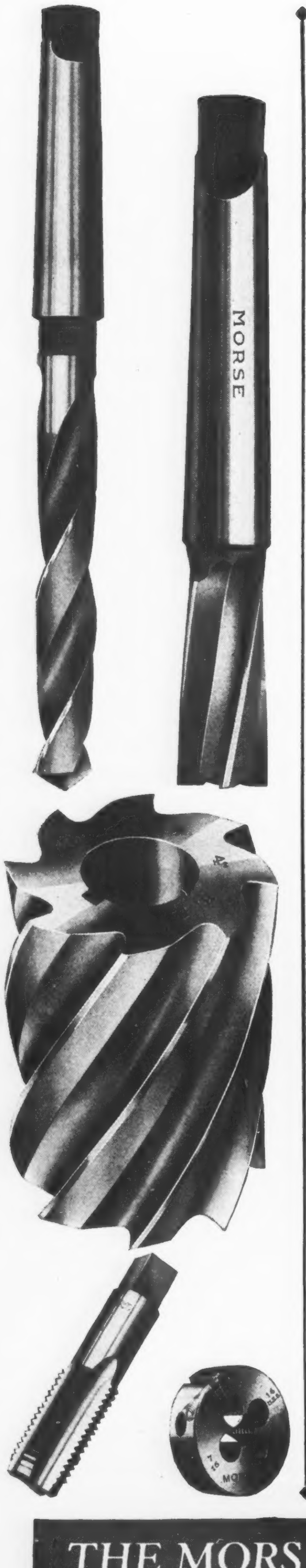
BECAUSE

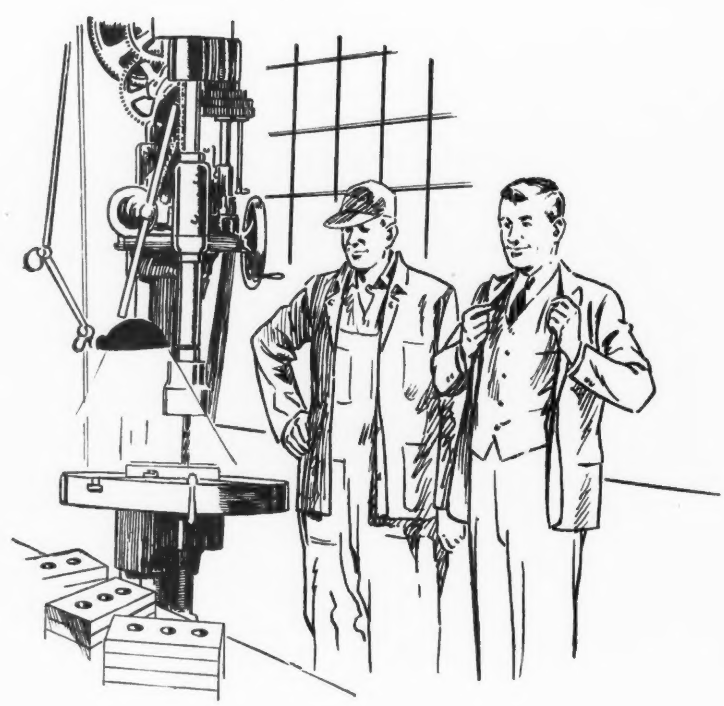
we know what has gone into the development of this die—the engineering ability, the research, the high grade material, the expert labor, the infinite care in grinding every working surface of both die head and chasers, including thread form. It has run the gauntlet of tests more severe than any shop conditions could possibly impose.

HENCE

J & L, without reservation, recommends this die as a rugged, long lived tool; and firmly believes it is unequaled for cutting accurate screw threads on a production basis.

MACHINE COMPANY
VERMONT, U. S. A.





Tools have got to be good to keep their jobs today

In today's rigid program of economy and efficiency there is no place for tools that delay production.

MORSE tools are holding their jobs and gaining new recognition right now for their ability to keep production speed up where it belongs and production cost down where it belongs.

MORSE
TWIST DRILL & MACHINE COMPANY
NEW BEDFORD, MASS., U.S.A.

THE MORSE LINE INCLUDES: *High Speed and Carbon*

DRILLS REAMERS CUTTERS TAPS AND DIES SCREW PLATES ARBORS
CHUCKS COUNTERBORES MANDRELS TAPER PINS SOCKETS SLEEVES

FOOTBURT

WAY DRILLS

HERE is a recent application of Footburt way drilling equipment for spot facing bolt bosses and spark plug holes on an automotive cylinder head. Each head has twenty-five spindles and is driven by 14″ cam unit ● There are four standard sizes of cam units with 6″, 10″, 14″ or 16″ diameter cams. They cover a wide range of capacity requirements and being unit type design can be placed at any advantageous position or angle.

o o o o

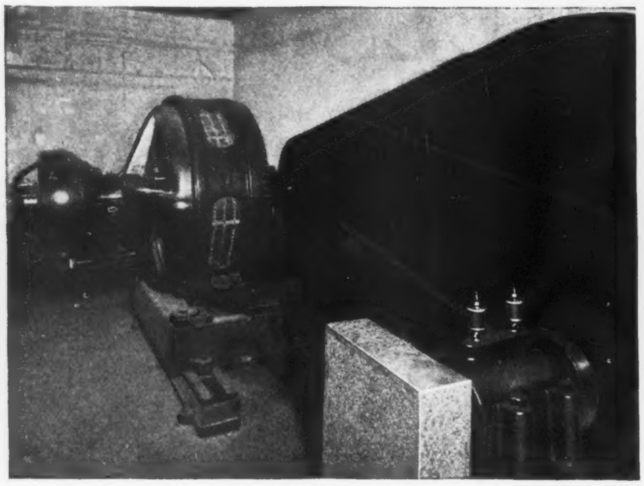
Why not send us your multiple drilling problems? We will be glad to work with you.

THE FOOTE-BURT COMPANY • CLEVELAND, OHIO

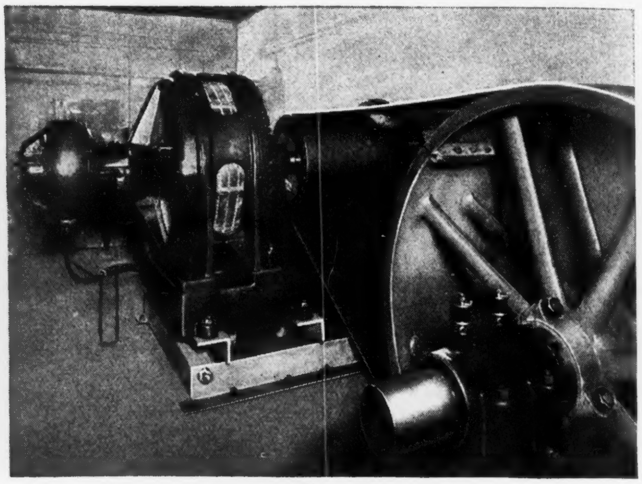
Detroit Office: 4-151 General Motors Building Chicago Office: 565 Washington Boulevard

Here Are The Facts

BEFORE **—AFTER**



CHAIN DRIVE



ROCKWOOD DRIVE

● FIFTEEN years ago, a large flour mill replaced with electric power its direct-connected steam engine driving the main lineshaft. A 300 H. P. motor was installed, connected to the lineshaft through a chain drive, regarded at that time as the "last word" in power transmission.

As time wore on, the chain drive became less satisfactory, requiring an increasing expense for maintenance and frequent repairs with replacement of parts.

During the past year, the trouble became so serious that a complete new drive was determined upon. Vibration of worn chain and sprockets threatened motor trouble; bearings were heating; the chain case required 4 to 6 gallons of oil per day; heat generated by worn parts raised the room temperature unnecessarily. Such unfavorable conditions could not be tolerated any longer.

● UNDER strong protests from the manufacturers of other drives, with intimations that the new drive would not solve the problem, the mill engineers authorized the installation of a ROCKWOOD Short-Center Flat Belt Drive, on a "satisfaction guaranteed" basis.

Chain and sprockets were replaced by a flat leather belt and pulleys. The 300 H. P. motor was mounted on a ROCKWOOD pivoted base, so as to use just the proper portion of the 13,000 lb. motor weight to automatically maintain correct belt tension.

Here are the results: 10 Horsepower less is required to drive the lineshaft, which operates 24 hours per day; 13° reduction in temperature of motor bearings; motor vibration practically gone; elimination of more than 20 barrels of oil a year for chain lubrication; room temperature reduced several degrees.

The mill engineers are highly satisfied with this ROCKWOOD Drive and regard it as the most practical drive for their application. . . . ROCKWOOD Drives are more efficient and require less maintenance than any other mechanical form of power transmission. ROCKWOOD engineers will be glad to advise you regarding any drive in your plant. All capacities up to 500 H. P.

THE ROCKWOOD MANUFACTURING CO.
INDIANAPOLIS, INDIANA

THE OHIO VALLEY PULLEY WORKS, INC.
MAYSVILLE, KENTUCKY

Divisions of General Fibre Products, Inc.

ROCKWOOD
SHORT-CENTER FLAT BELT DRIVE

This is ACCURACY in flat wire!

Put a "mike" on this fine specimen of cold-rolled high carbon steel flat wire and you find that its thickness accuracy is held within .0002" plus and minus. It is a wire that requires exceptionally skilful rolling and rigid checking throughout every step of manufacture.

Similar narrow and thin sections of high carbon steel flat wire are made by Roebling to various specifications, in untempered, tempered, polished, blued and straw-color finishes, and within correspondingly close dimensional tolerances.

We invite your inquiry regarding this or other high quality cold-rolled steel flat wire. We are especially well-equipped to make high carbon "flats", and are also ideally set up to make low carbon flat wire.

JOHN A. ROEBLING'S SONS CO., TRENTON, N.J.

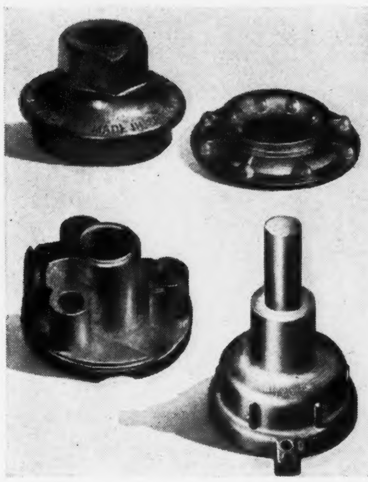
Wire · Wire Rope · Copper and Insulated Wires and Cables
Welding Wire · Flat Wire · Wire Cloth and Wire Netting

New York, Boston, Chicago, Philadelphia, Atlanta, Cleveland, Seattle, San Francisco, Los Angeles, Portland Export Dept., New York, N.Y.

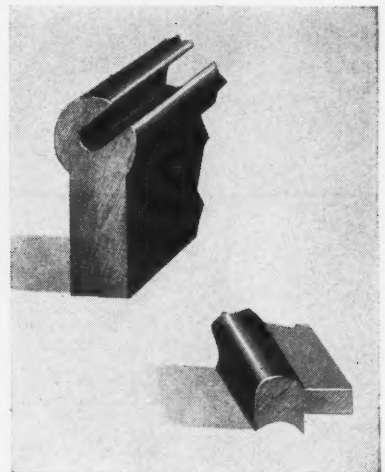
ROEBLING FLAT WIRE

Faster production . . . Lower costs *with*

Plastic Machining



Typical Revere (Twice-wrought) Brass Forgings.



Typical cross-sections of Revere Extruded Shapes.

Plastic Machining is pre-machining by us, while we have the metal heated to a semi-plastic form. It means that the Revere Brass Forgings or Extruded Shapes you receive, are well on the way to becoming your finished part or product. It means fewer operations and much less machining for you.

Figure out the advantages of this factor alone . . . in faster production, in lowered costs!

Now, add the advantages of the metal itself:

REVERE BRASS FORGINGS . . . being twice-wrought . . . have uniformity and density of structure, high tensile strength and consistent accuracy of dimensions. What machining you have to do, is not only reduced to a minimum, but can be done at high speeds. Handling is more rapid, work more accurate in jigs. Automatic or semi-automatic machine feeding is possible. Also, Revere Brass Forgings are free from defects. There are no rejects and scrap is reduced to a minimum.

REVERE EXTRUDED SHAPES . . . when used with special holders or chucks . . . may be fed into turret lathes or screw machines in long lengths. They may be turned and drilled as readily as concentric rod. They may be sawed into short lengths and hot or cold forged with great economy in press operations. Important savings in amount of flash (which is waste) results. Here, also, the close grain of the metal eliminates defects, pin-holes, etc.

It will pay you to find out how Revere Plastic Machining can serve you and save you money. For complete information address Revere Copper and Brass Incorporated, 230 Park Ave., New York City.

Revere Copper *and* Brass

INCORPORATED

Revere COPPER BRASS Products

Baltimore *Division, Baltimore, Md.* Michigan *Division, Detroit, Mich.* Higgins *Division, Detroit, Mich.*
Dallas *Division, Chicago, Ill.* Taunton-New Bedford *Division, Taunton, Mass.* Rome *Division, Rome, N. Y.*

EXECUTIVE OFFICES: NEW YORK CITY
GENERAL OFFICES: ROME, N. Y.

Steel

to Cut with —
to Build with

Steel

Castings
Forgings
Sheet
Strip
Screw Stock
Wire
Rod
Tool Steel
H. S. Steel
Stainless Steel

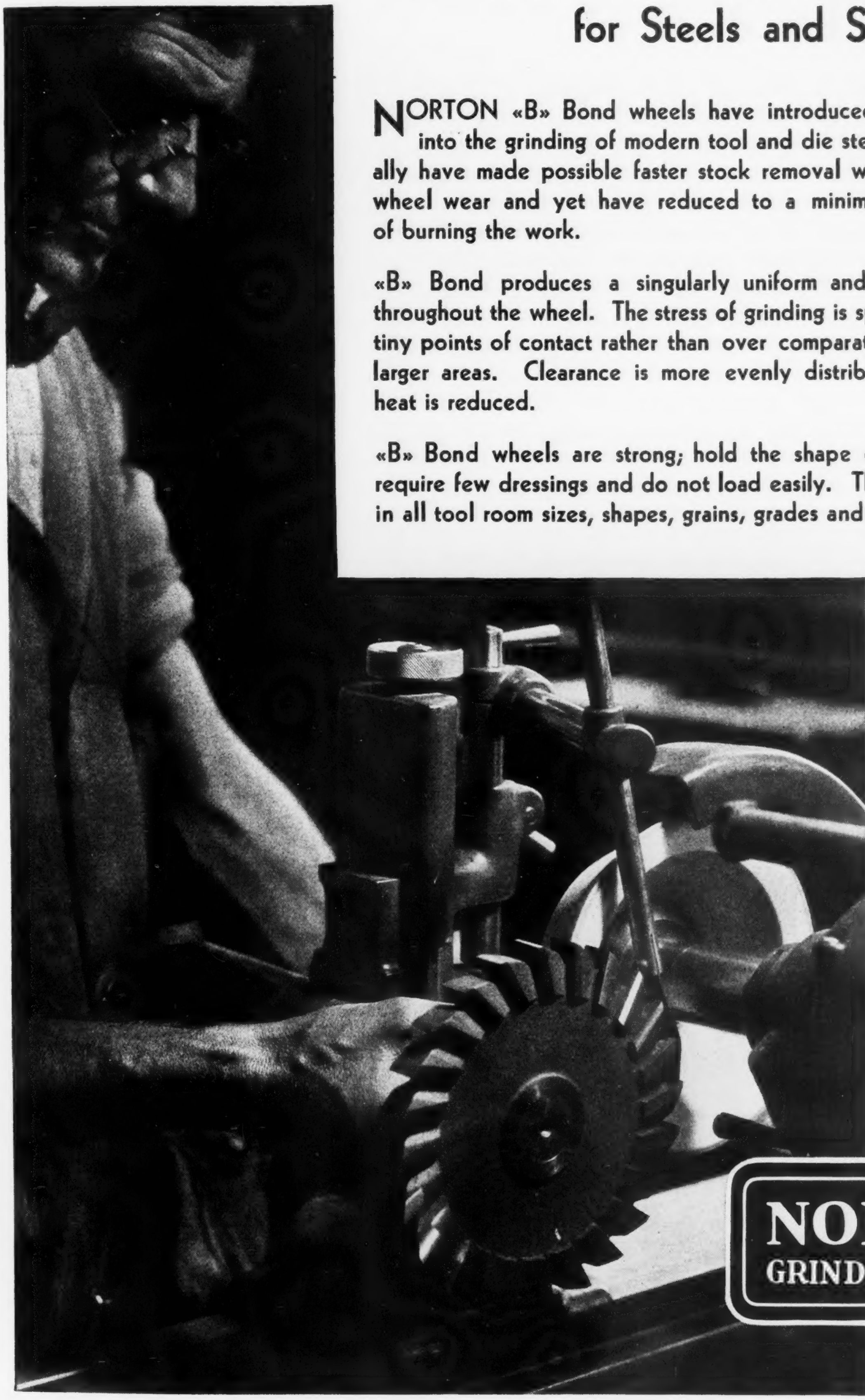
Steel

In All Forms
Finds no Better
Market Place than
MACHINERY'S
Materials Section

Cut Faster — Last Longer — Yet Do Not Burn

NORTON «B» BOND WHEELS

for Steels and Steel Alloys



NORTON «B» Bond wheels have introduced new efficiency into the grinding of modern tool and die steels. They actually have made possible faster stock removal without increasing wheel wear and yet have reduced to a minimum the dangers of burning the work.

«B» Bond produces a singularly uniform and stable structure throughout the wheel. The stress of grinding is spread over many tiny points of contact rather than over comparatively fewer and larger areas. Clearance is more evenly distributed. Grinding heat is reduced.

«B» Bond wheels are strong; hold the shape of their corners; require few dressings and do not load easily. They are available in all tool room sizes, shapes, grains, grades and *structures.*

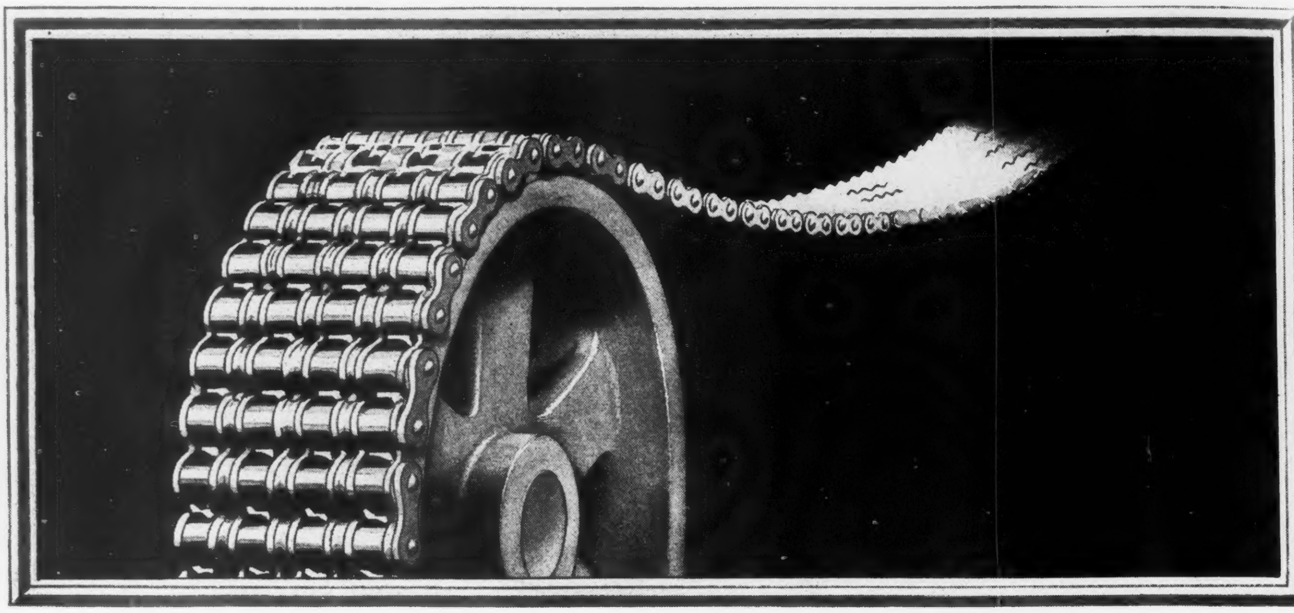
NORTON
COMPANY
Worcester,
Mass.

New York Chicago
Philadelphia Detroit
Pittsburgh Hartford
Cleveland
Hamilton, Ontario
London Paris
Wesseling, Germany

W-417

NORTON
GRINDING WHEELS

CHAIN BELT COMPANY



REX Roller Chain—the New Distinguished Member of a Famous Family

A bit of history:

The Chain Belt Company was organized in 1891 to manufacture standard malleable iron chains of that day.

1905—Rex Griplock, with the hidden shoulders was patented—first of a long line of superior Rex chains.

1911—Chabelco, the heavy duty steel chain, famed for its unit link, appeared.

1918—Rex Unicast was perfected, the malleable roller chain with the one piece link, that greatly simplified eccentric loading of conveyors.

1921 appeared Durobar—the combination chain with the added metal that ended bad sprocket action supposedly inherent in combination chain.

1931 saw the addition of the new Rex Roller Chain, a steel roller chain of a high degree of finish with pitch and all dimensions maintained within extremely close limits of accuracy.

Meanwhile, many standard chains have been developed—and all steadily improved in metal and in accuracy of building and resulting Uniformity. So, today, the manufacturer finds in the line of the Chain Belt Company, a chain for virtually any requirement, interchangeable with other standard makes, and in addition, the outstanding Rex Chains for specialized applications.

A new catalogue is ready. It will be sent upon request.

Use the coupon below

CHAIN BELT COMPANY, 1602 West Bruce Street, Milwaukee, Wisconsin

Please send the catalog on Rex Roller Chain to:

Name.................................... **Title**....................................

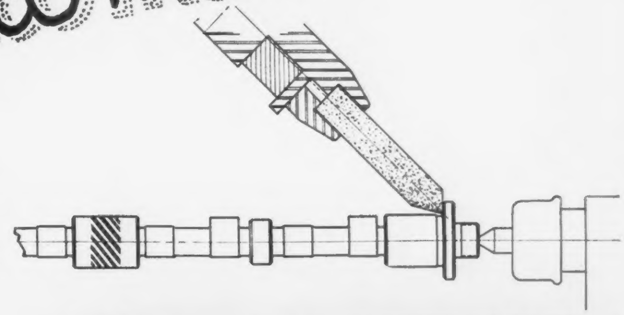
Firm Name..

Address.............................. **City**.......................... **State**..............

REX ROLLER CHAIN

Established 1891—Branch Offices in 17 Cities

This Type C Landis Hydraulic Grinder is Fully Semi-Automatic

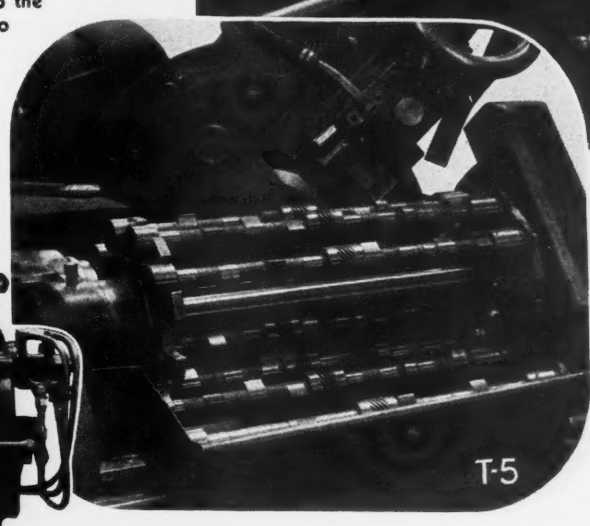


SHOWN here is an interesting semi-automatic application on the new Landis Type C Hydraulic. The operation is polish grinding the underside of a camshaft flange. Should there be any great amount of stock removal necessary, exactly the same equipment would be used to grind instead of polish grind; the only difference would be in the selection of the grinding wheel.

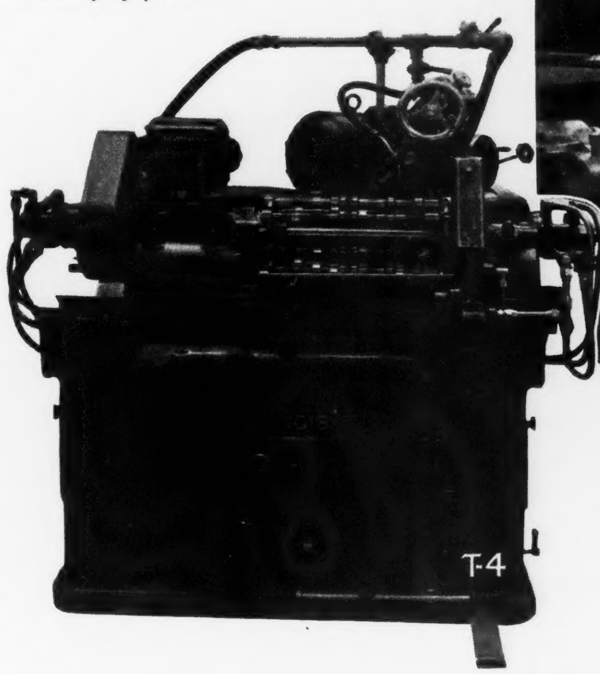
The wheel base is set at an angle and the face of the wheel is trued V shaped in order that its front cutting edge will be well supported. Only the minimum number of operations are manual, the remaining are automatic. All the operator does is keep the work turret loaded and depress the foot pedal at the front of the machine. Assuming that a flange has just been completed the foot pedal is depressed with the following cycle of operations taking place.

To begin with, the wheel moves away rapidly to its starting position. Then the work rotation stops, the work holding collet releases and withdraws into the head, the footstock center withdraws and finally the turret indexes, bringing the next camshaft into position. As soon as this takes place the foot pedal automatically unlatches causing the footstock center to advance, the work holding collet to advance and grip the work, the wheel base to move forward and work rotation to again start. The indexing turret carries the finished shaft around to the front of the table where it is deposited, thereby enabling the operator to transfer it easily to the conveying system.

T-6



T-5



T-4

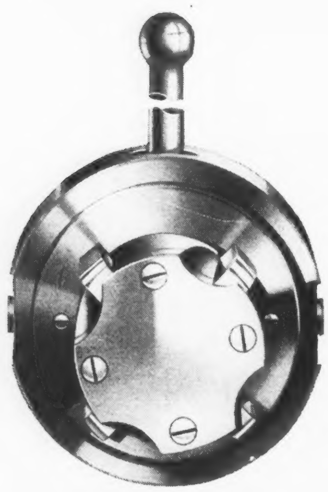
ALTHOUGH so many of the machine movements are automatic they are smooth, quiet and well coordinated because of the skillful application of hydraulic power. This actuates the wheel base, work holding collet, footstock center, work indexing turret and even the diamond holder. The same sound principles of grinding machine engineering, as applied to this machine, would work out advantageously in your grinding department applied to many of the available types of modern Landis grinding equipment.

LANDIS TOOL CO. WAYNESBORO PA

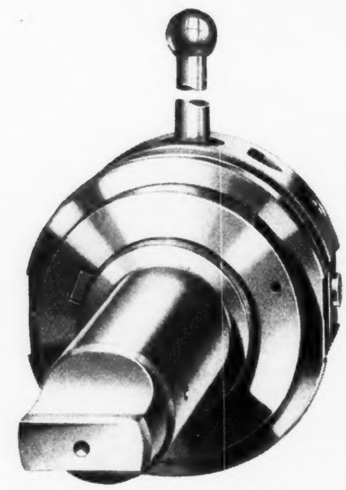
DETROIT•CHICAGO•NEWARK•PHILADELPHIA

118

PROTECTED!



FRONT VIEW



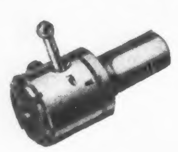
REAR VIEW

Dirt and chips CAN'T work into the Geometric Class S Taps to destroy the tool and spoil the work because it is fully enclosed—COMPLETELY PROTECTED against just this danger.

Then, too, the trip plate is snugly mounted over the tool proper with no projections or pockets for chips to clog up and jam the tap, causing torn threads and destroying its efficiency.

Completely efficient design makes this simple rugged tool an efficient producer of highly accurate internal threads.

ANOTHER GEOMETRIC TOOL



Style KH Stationary Self-Opening Die Head for use on hand screw machines, turret lathes, etc. Chasers interchangeable with those of other K Type Die Heads.

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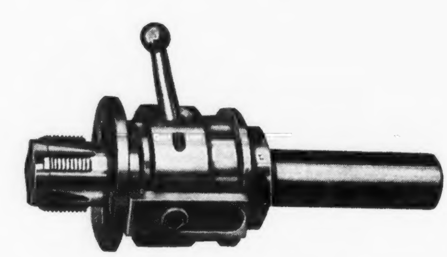

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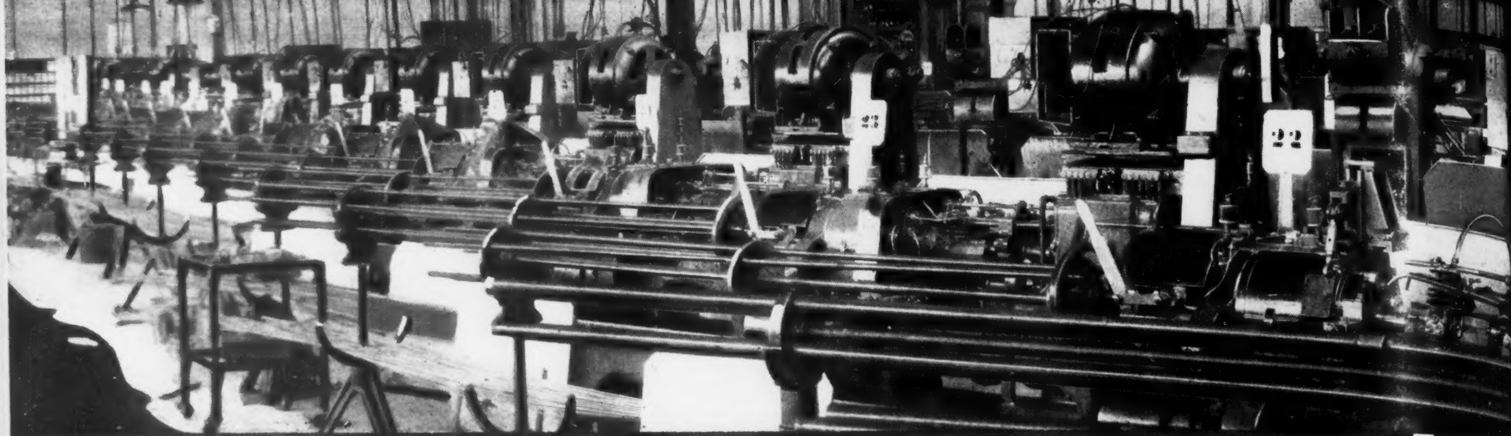
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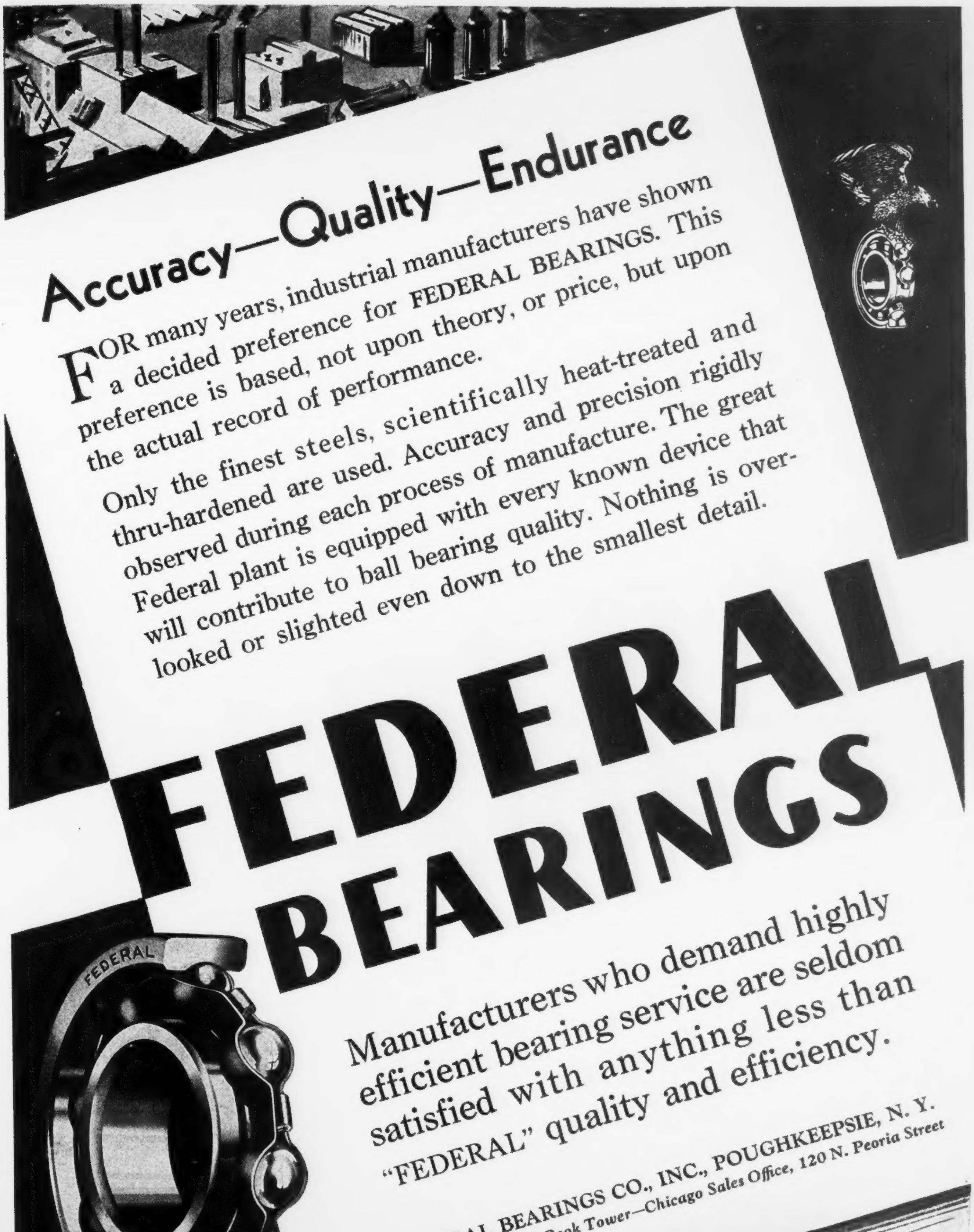
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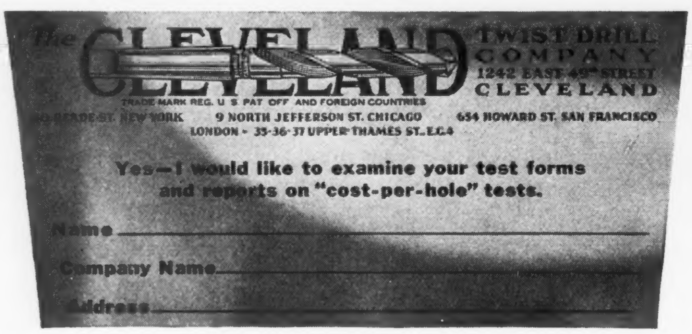
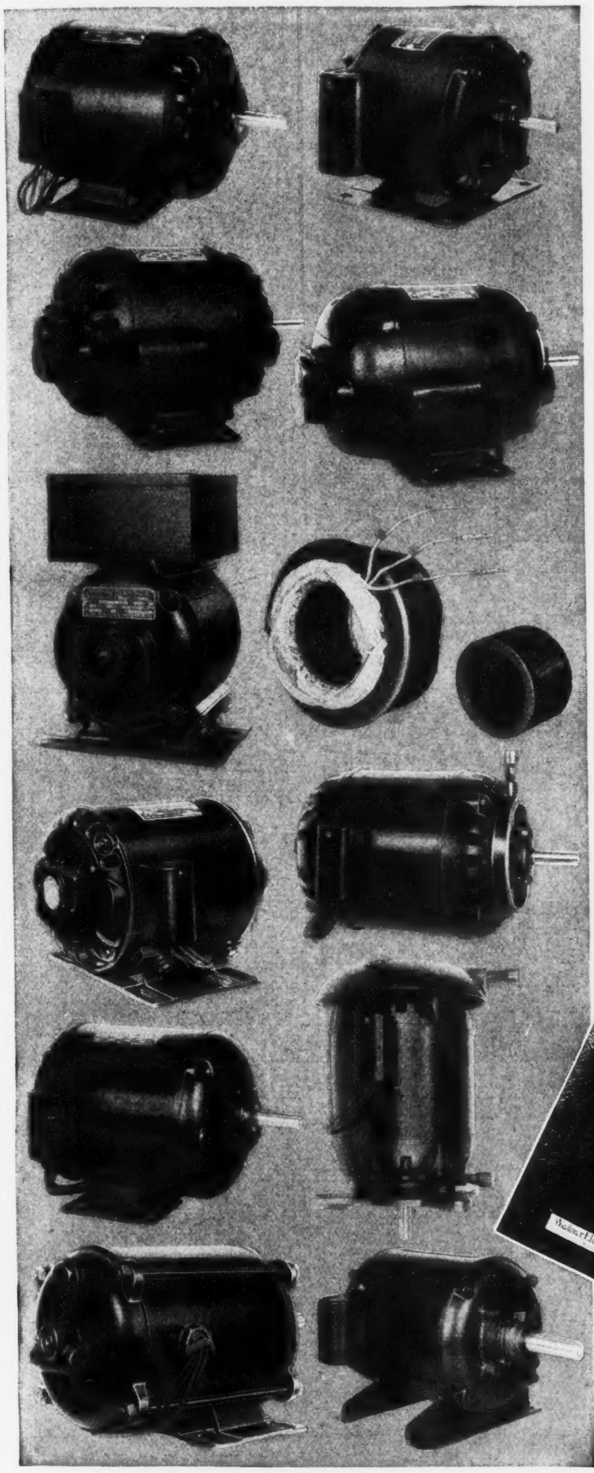


Diversified

to meet all small-motor requirements



A line of small motors intended for application on motor-driven machinery must include all the electrical and mechanical types required by the machinery manufacturer—for a *single* source of *all* types is far more desirable than a number of sources of incomplete lines of motors.

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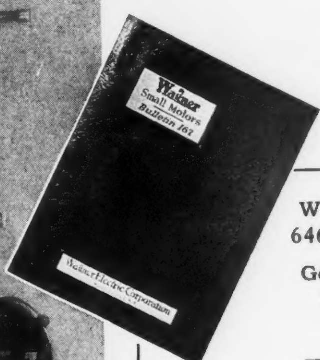

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Wagner Electric Corporation
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Please send copy of Bulletin 167 on small motors

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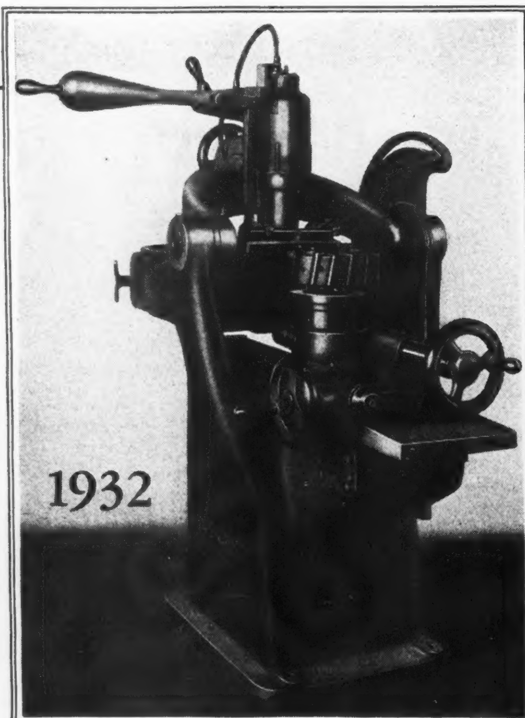

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1911

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200-606

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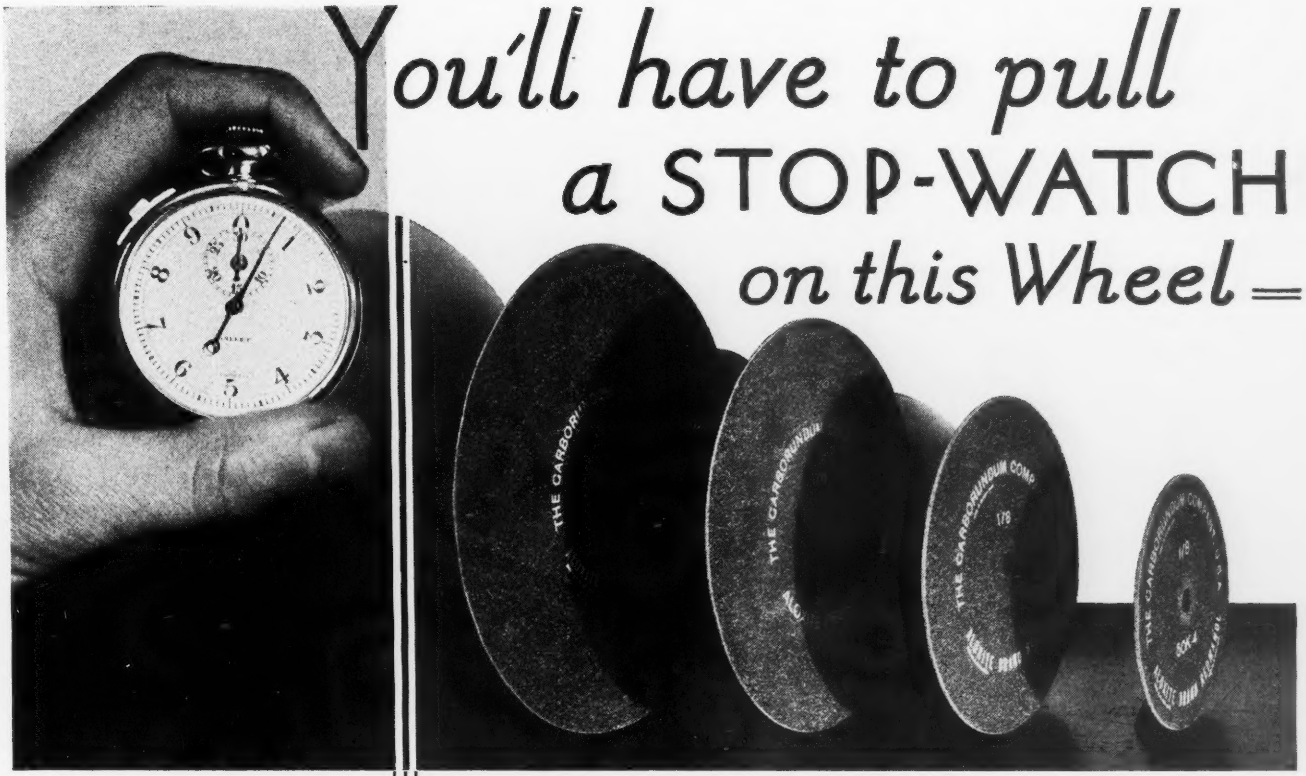
You'll have to pull a STOP-WATCH on this Wheel—



IT'S merely a matter of split seconds in timing the work of the Aloxite Brand Redmanol Cut-off Wheel.

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Comparable speed records are made on other metals.

And you can run this wheel with safety up to 16,000 S.F.P.M.

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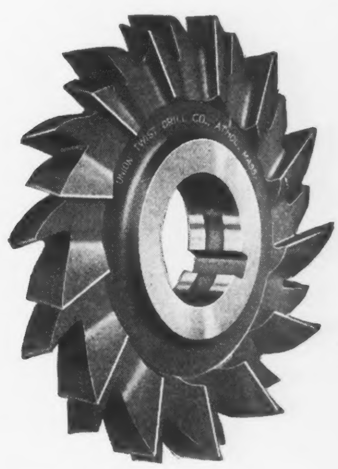

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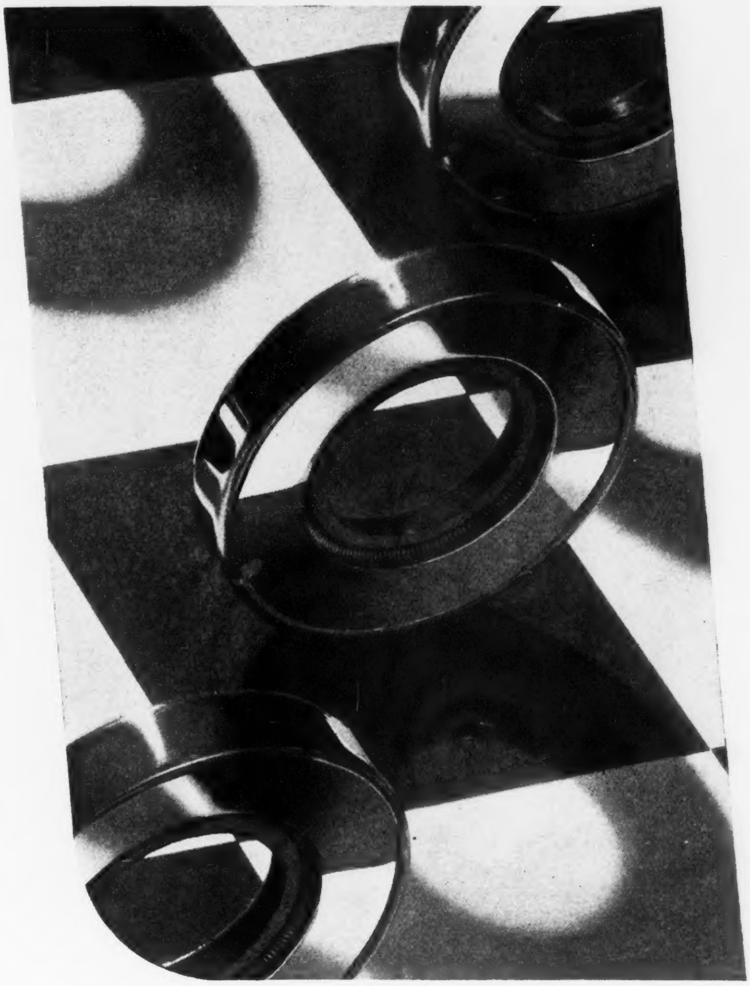

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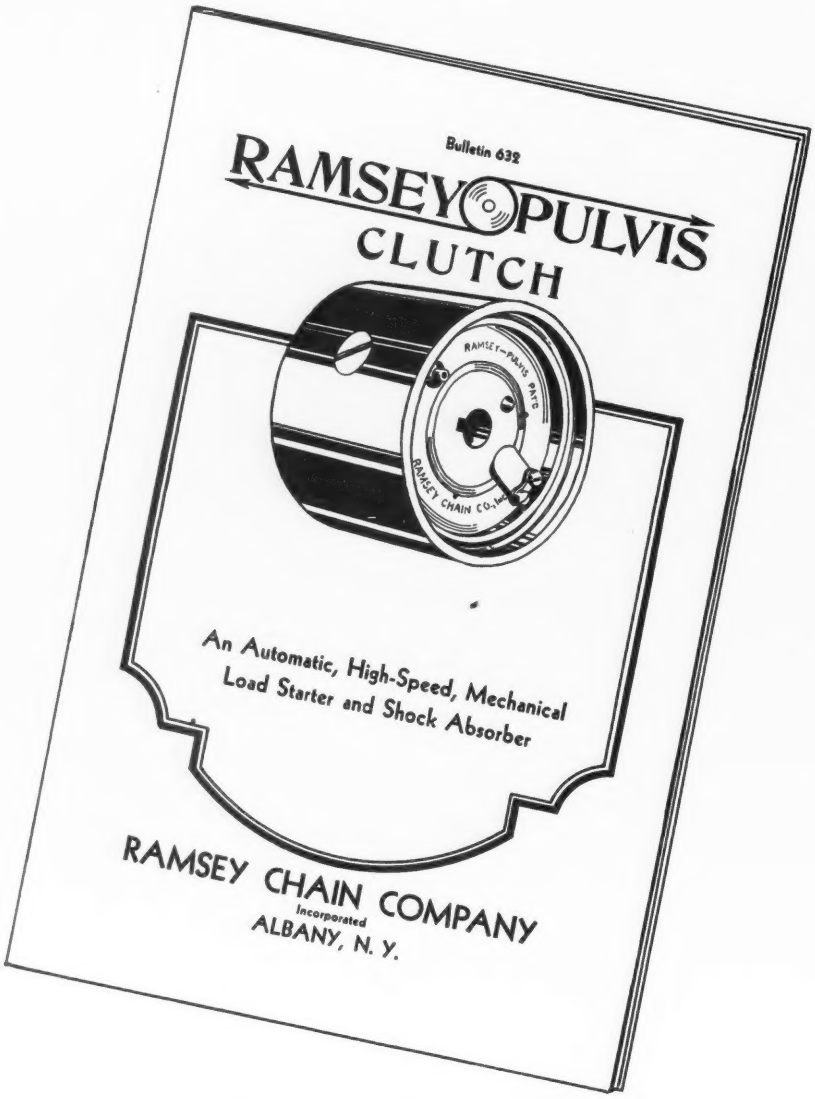

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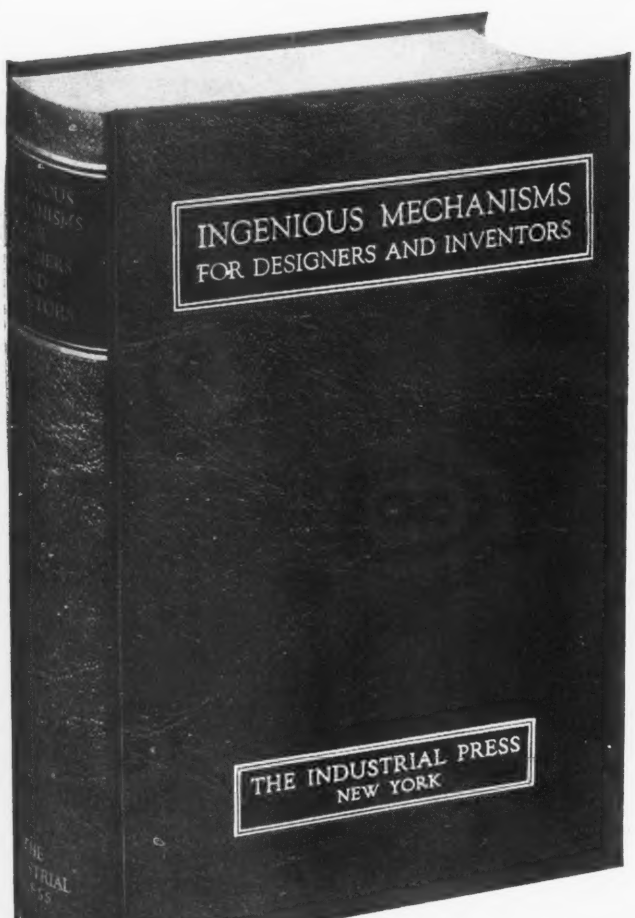

Chapter headings indicate the scope and method of classifying the material in this book.

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Overload Relief Mechanisms and Automatic Safeguards
Interlocking Devices
Driving Mechanisms for Reciprocating Parts
Quick-return Motions for Tool Slides
Speed-changing Mechanisms
Differential Motions
Straight-line Motions
Miscellaneous Mechanical Movements
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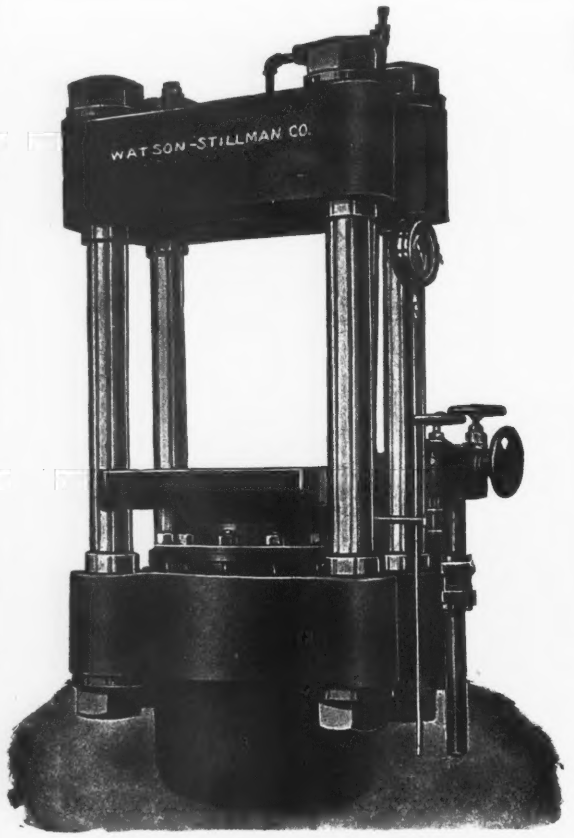

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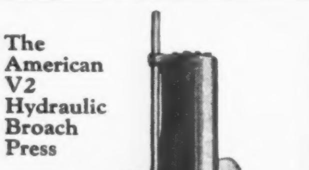

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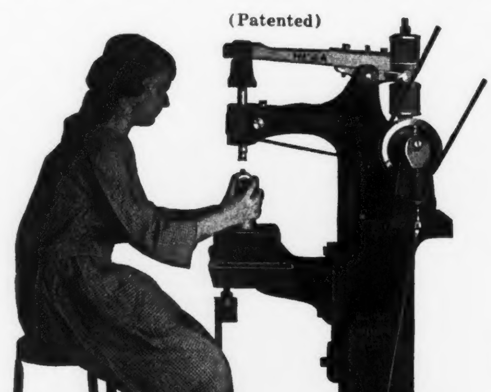

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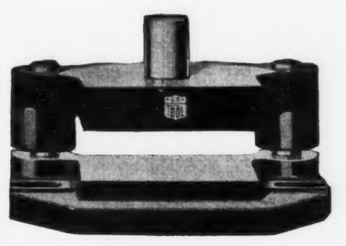

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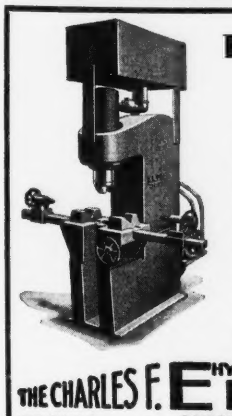

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Automatic Stop on "Up-Stroke."

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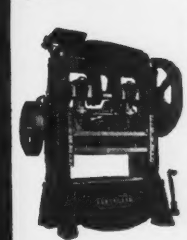
Power Presses



THE Cleveland line of power presses embraces every type and size from the smallest open back inclinable to the largest 4 point suspension.

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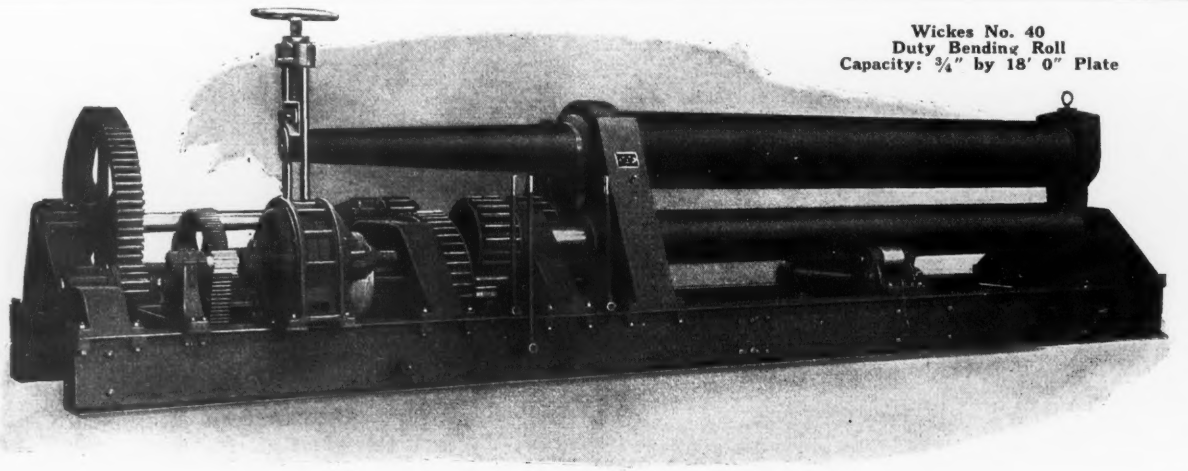

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- Flanging Clamps
- Wall Radial Drills
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NIAGARA

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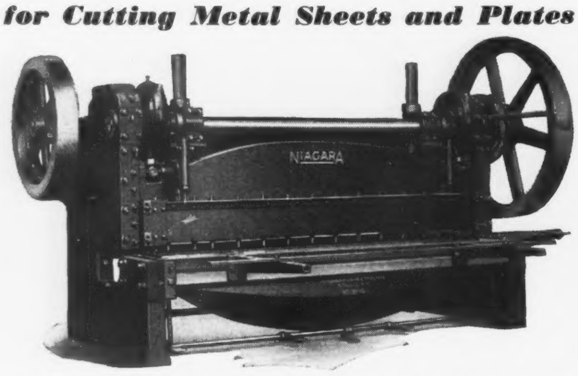

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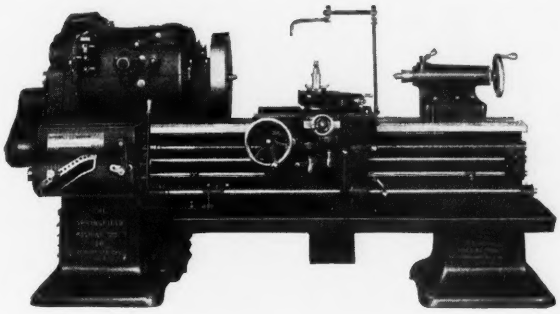

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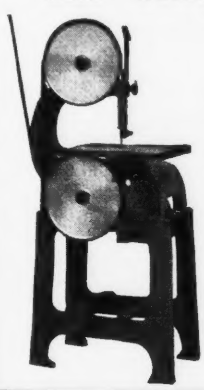

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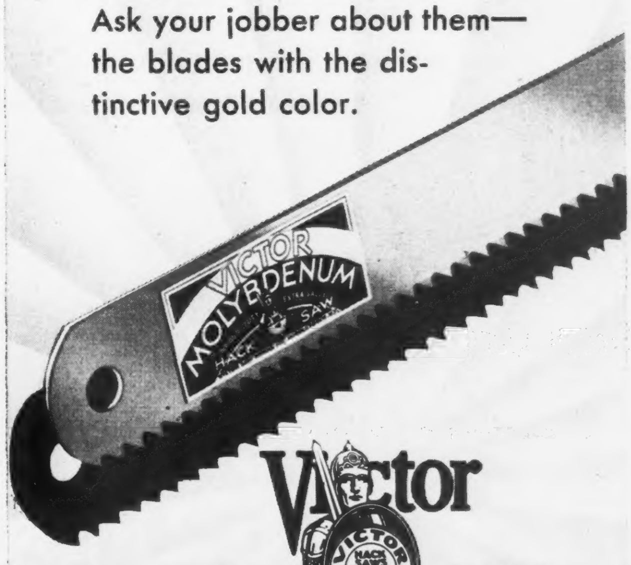

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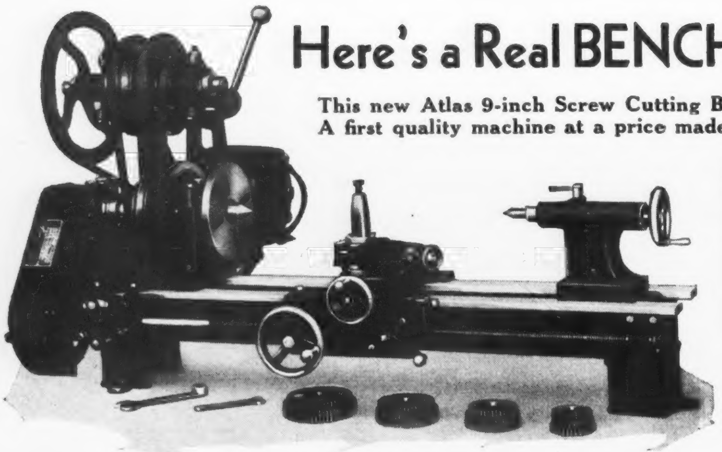

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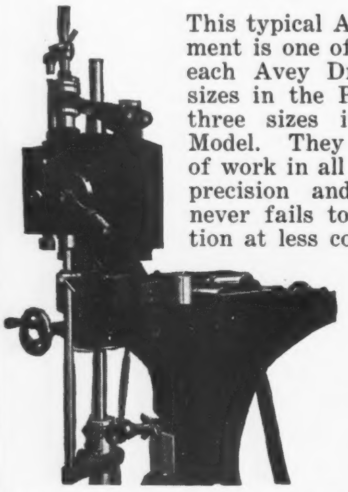

This typical Avey Tapping Attachment is one of two styles made for each Avey Drilling Machine—five sizes in the Plain Tapping Model, three sizes in the Back Geared Model. They perform every class of work in all metals, with a speed, precision and dependability that never fails to bring more production at less cost.

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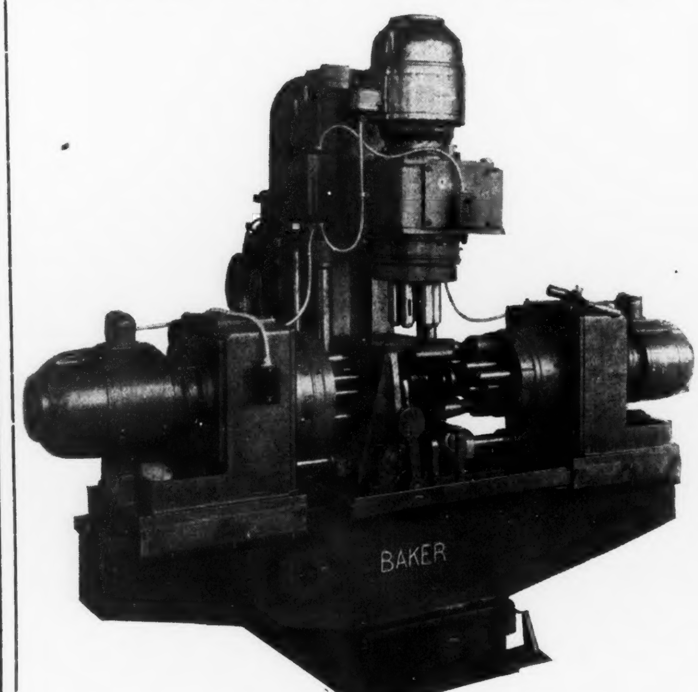

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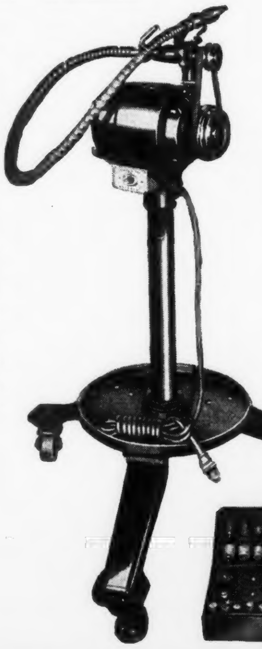

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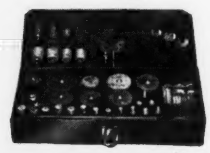

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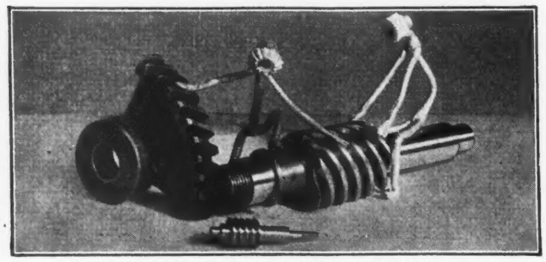

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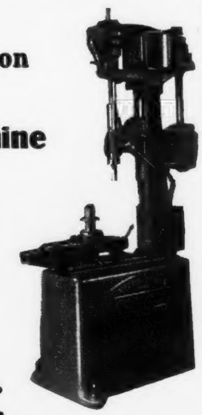

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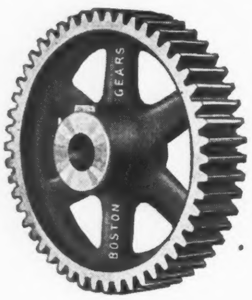

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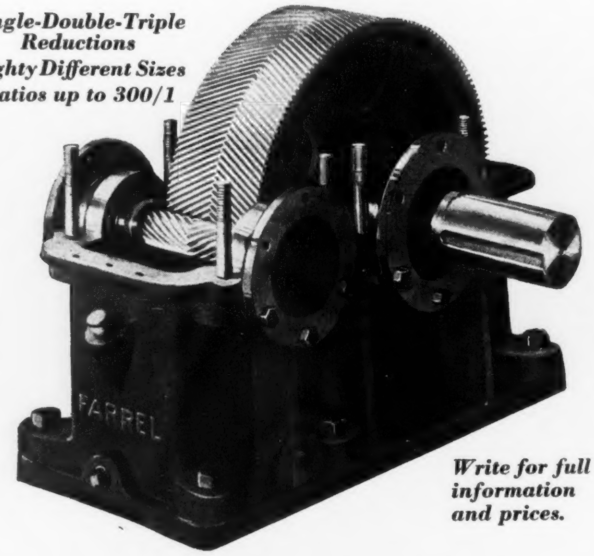

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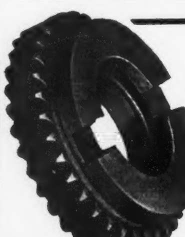

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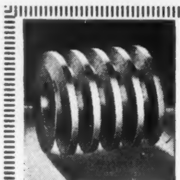

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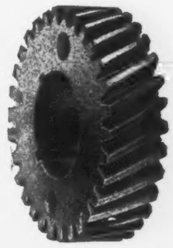

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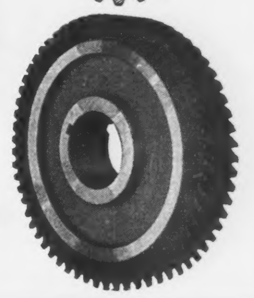

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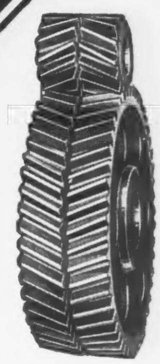

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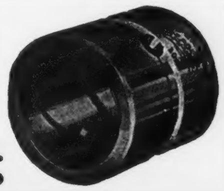

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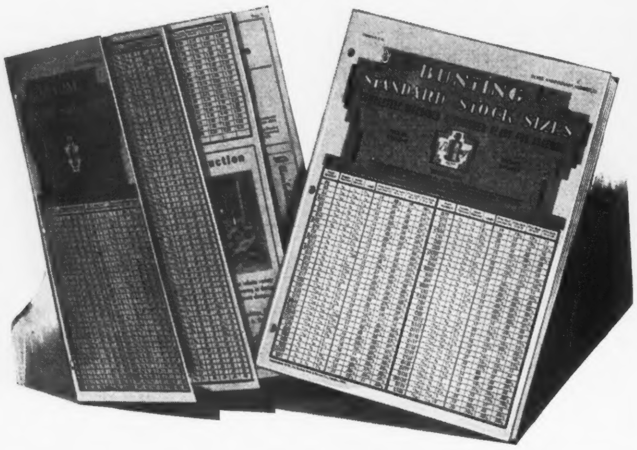

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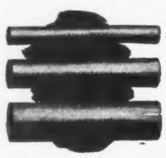

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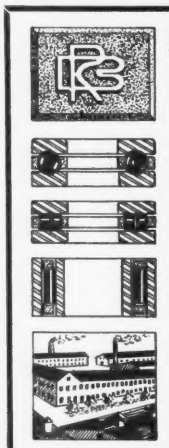

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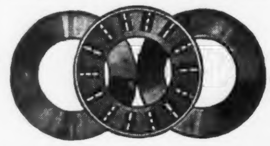

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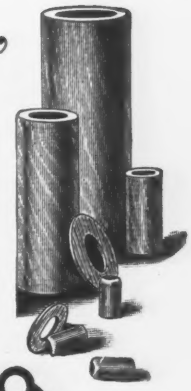

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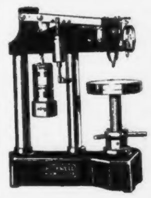

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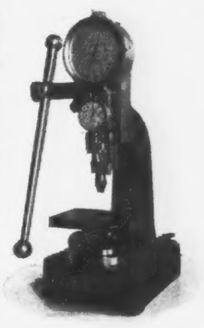

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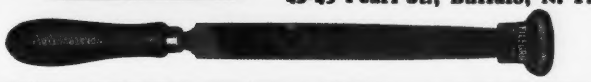

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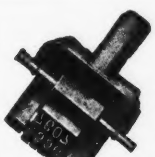

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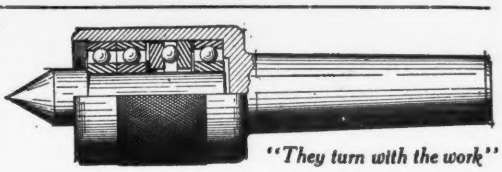

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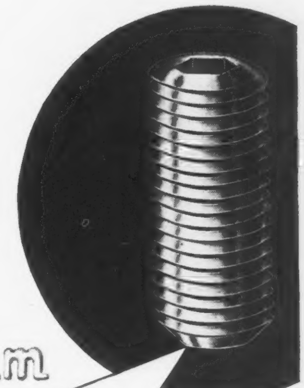

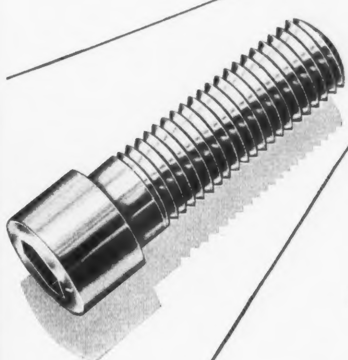

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Miles Machinery Co., Saginaw, Mich.
Osgood, J. L., Mchry. & Tool Co., Inc., Buffalo, N. Y.

DEMAGNETIZERS
Heald Machine Co., Worcester, Mass.
Walker, O. S., Co., Inc., Worcester, Mass.

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Hartford Special Mchry. Co., Hartford.
Manufacturers' Consulting Engineers, Syracuse, N. Y.
Ruthman Machinery Co., 530 E. Front St., Cincinnati, O.

DIE CASTING MACHINES
Madison-Kipp Corp., Madison, Wis.

DIE CASTINGS
See Castings, Die or Permanent Mold.

DIE MAKERS' SUPPLIES
Baumbach, E. A., Mfg. Co., 1810 S. Kilbourn Ave., Chicago.
Danly Mch. Specialties, Inc., 2112 S. 52nd Ave., Chicago.
U. S. Tool Co., Inc., Ampere, N. J.

DIE MAKING MACHINES
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

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U. S. Tool Co., Inc., Ampere, N. J.

DIE SINKING MACHINES
Gorton, Geo., Mch. Co., 1109 13th St., Racine, Wis.
Preis Engraving Machine Co., 227 Fulton St., New York.

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DIES, LETTERING AND EMBOSSING
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DIES, SHEET METAL, ETC.
Baumbach, E. A., Mfg. Co., 1810 S. Kilbourn Ave., Chicago.
Bliss, E. W., Co., Brooklyn, N. Y.
City Mch. & Tool Wks., Dayton, O.
Columbus Die, Tool & Mch. Co., Columbus, O.
Danly Mch. Specialties, Inc., 2112 S. 52nd Ave., Chicago.
Ferracute Machine Co., Bridgeton, N. J.
Modern Machine Corp., 285 N. 6th St., Brooklyn, N. Y.
Niagara Mch. & Tool Works, Buffalo.
Taylor-Shantz Co., Rochester, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
Tomkins-Johnson Co., Jackson, Mich.
U. S. Tool Co., Inc., Ampere, N. J.
V. & O. Press Co., Hudson, N. Y.
Waltham Mch Wks., Waltham, Mass.

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Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Murchey Mch. & Tool Co., 951 Porter St., Detroit, Mich.
National Acme Co., Cleveland.
Ruthman Machinery Co., 530 E. Front St., Cincinnati, O.
Standard Tool Co., Cleveland.

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Eastern Mch. Screw Corp., New Haven, Conn.
Errington Mechanical Laboratory, 200 Broadway, N. Y.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Pa.
Murchey Mch. & Tool Co., 951 Porter St., Detroit.
National Acme Co., Cleveland.

DIES, THREADS, ROLLING
Hanson-Whitney Mch. Co., Hartford, Conn.

DISCS, ABRASIVE
Carborundum Co., Niagara Falls, N. Y.

DIVIDING HEADS
See Milling Machines, Horizontal, Universal.

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Baumbach, E. A., Mfg. Co., 1810 S. Kilbourn Ave., Chicago.
Danly Mch. Specialties, Inc., 2112 S. 52nd Ave., Chicago.

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Bridgeport Safety Emery Wheel Co., Inc., 1283 W. Broad St., Bridgeport, Conn.
Calder Co., Geo. H., Lancaster, Pa.
Norton Co., Worcester, Mass.
Standard Tool Co., Cleveland.

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Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.

DRILL HEADS, MULTIPLE
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Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Errington Mechanical Laboratory, 200 Broadway, New York.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Providence, R. I.
United States Drill Head Co., Cincinnati.

DRILL SOCKETS
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

DRILL SPEEDERS
Graham Mfg. Co., Providence, R. I.
Hoefer Mfg. Co., Freeport, Ill.

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Morse Twist Drill & Mch. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

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Moline Tool Corp., Moline, Ill.

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Baker Bros., Inc., Toledo, O.
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Providence, R. I.

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Avey Drilling Mch. Co., Cincinnati.
High Speed Hammer Co., Inc., Rochester, N. Y.
Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.

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Foote-Burt Co., Cleveland, O.
Niles Tool Work Co., Hamilton, Ohio.

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Baker Bros., Inc., Toledo, O.
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Foote-Burt Co., Cleveland, O.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
Niles Tool Works Co., Hamilton, Ohio.

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Langelier Mfg. Co., Providence, R. I.
Murchey Mch. & Tool Co., 951 Porter St., Detroit.

DRILLING MACHINES, MULTIPLE SPINDLE
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Baker Bros., Inc., Toledo, O.
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Foote-Burt Co., Cleveland, O.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
Niles Tool Works Co., Hamilton, Ohio.
United States Drill Head Co., Cincinnati.

DRILLING MACHINES, RADIAL
Carlton Mch. Tool Co., Cincinnati.
Niles Tool Works Co., Hamilton, Ohio.

DRILLING MACHINES, RAIL
Baker Bros., Inc., Toledo, O.
Defiance Machine Co., Defiance, O.
Foote-Burt Co., Cleveland, O.
General Electric Co., Schenectady, N. Y.
Moline Tool Co., Moline, Ill.

DRILLING MACHINES, SENSITIVE
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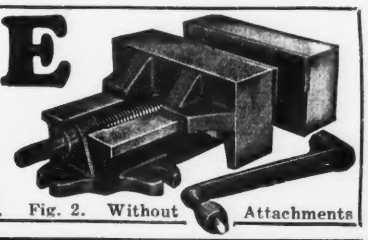
Foote-Burt Co., Cleveland, O.
High Speed Hammer Co., Inc., Rochester, N. Y.
Langelier Mfg. Co., Providence, R. I.
Leiman Bros., 152 Christie St., Newark, N. J.
Leland-Gifford Co., Worcester, Mass.

VISE



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18, 24, 48" Cincinnati Plain Auto. belt dr.
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4" Pratt & Whitney Spline Miller.
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24"x12' LeBlond, cone head.
24"x10' Boye & Emmes, cone head.
21"x10' LeBlond. cone head.
20"x10' American, geared head.
18"x8' American, geared head.
18"x8' Lodge & Shipley, selective head.
17"x8' Sidney cone head.
16"x12' American geared head.
16"x6' Cisco cone head.
12"x5' Hendey cone head.

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10x8" Chicago Pneumatic Air Compressor, class NSB.
14x14" Bury Class L Air Compressor.
18x12x12" Worthington Steam Driven Air Compressor.
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21" and 24" Gisholt Turret Lathes.
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Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.

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Greenfield Tap & Die Corp., Greenfield, Mass.
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Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

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Binghamton Flexible Shaft Co., Johnson City, N. Y.
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Standard Electrical Tool Co., 1936 W. 8th St., Cincinnati.

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Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

DRILLS, SQUARE AND HEXAGON
Watts Bros. Tool Wks., Wilmerding, Pa.

DRILLS, TWIST
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Colton, Arthur, Co., 2618 Jefferson Ave., E., Detroit, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Red-Line Reamer Co., Millersburg, Pa.
Standard Tool Co., Cleveland, O.
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DRILLS, WIRE
Union Twist Drill Co., Athol, Mass.

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ELEVATORS
Link-Belt Co., Chicago, Ill.

EMERY WHEELS
See Grinding Wheels.

EMERY WHEEL DRESSERS
See Dressers, Grinding Wheel.

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Revere Copper and Brass Inc., 230 Park Ave., New York City.

FORGINGS, IRON AND STEEL
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GAGES, DIAL
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Federal Products Corp., Providence.
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Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.

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Farrel-Birmingham Co., Inc., 377 Vulcan St., Buffalo, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Ferguson Gear Co., Gastonia, N. C.
General Electric Co., Schenectady, N. Y.
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Hartford Special Mchy. Co., Hartford.
Link-Belt Co., Chicago, Ill.
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Toledo Mch. & Tool Co., Toledo, O.

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Diefendorf Gear Corp., Syracuse, N. Y.
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Ferguson Gear Co., Gastonia, N. C.
General Electric Co., Schenectady, N. Y.
Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mchy. Co., Hartford.
Massachusetts Gear & Tool Co., 34 Nashua St., Woburn, Mass.
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Newark Gear Cutting Mch. Co., Newark, N. J.
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Madison-Kipp Corp., Madison, Wis.

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GRINDING MACHINES, ABRASIVE BELT
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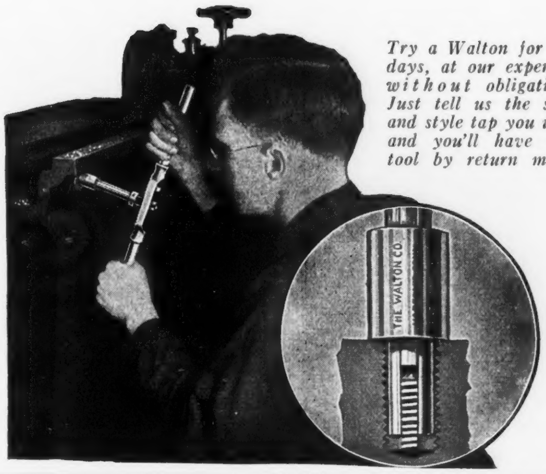

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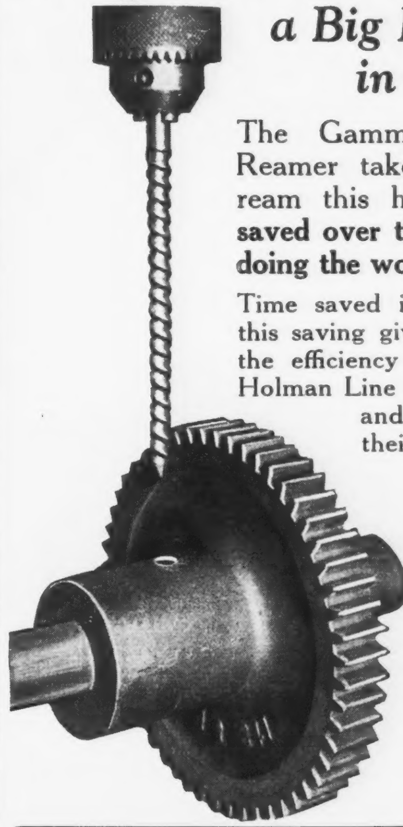

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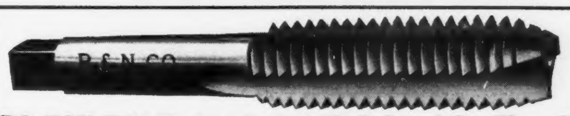

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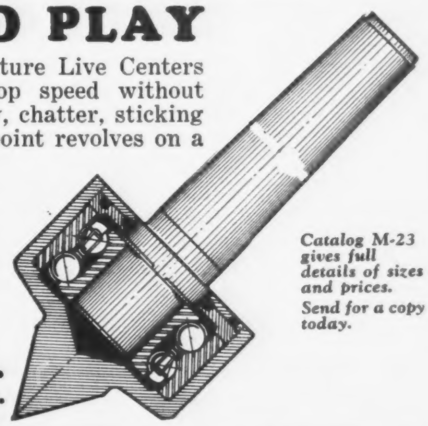

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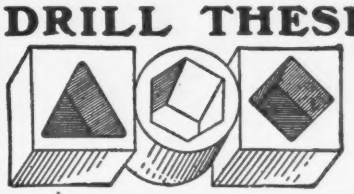

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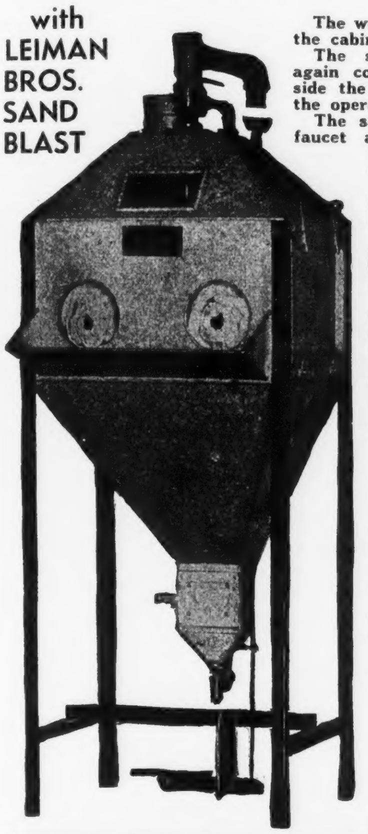

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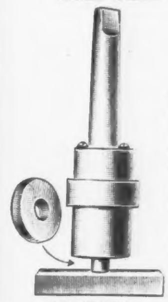

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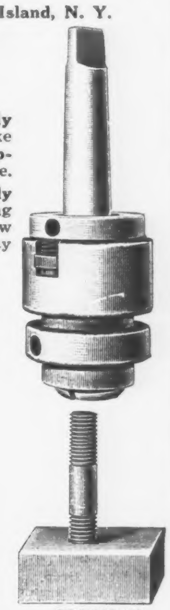

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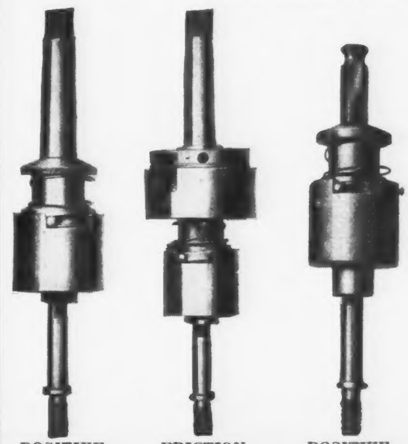

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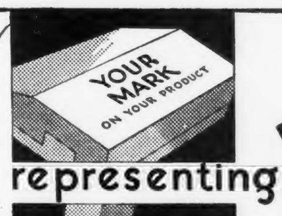

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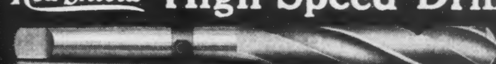

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Niles Tool Works Co., Hamilton, O.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Wickes Bros., Saginaw, Mich.

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Hartford Steel Ball Co., Hartford, Ct.
Production Mch. Co., Greenfield, Mass.

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Atlas Press Co., Kalamazoo, Mich.
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Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago.
Lucas Machine Tool Co., Cleveland.
Tomkins-Johnson Co., Jackson, Mich.
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Atlas Press Co., Kalamazoo, Mich.
Bliss, E. W., Co., Brooklyn, N. Y.
Ferracute Machine Co., Bridgeton, N. J.
Lapointe Mch. Tool Co., Hudson, Mass.
Lucas Machine Tool Co., Cleveland.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.
Watson-Stillman Co., 107 Aldene Rd., Roselle, N. J.

PRESSES, DROP
See Hammers, Drop.

PRESSES, FOOT
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Bliss, E. W., Co., Brooklyn, N. Y.
Ferracute Machine Co., Bridgeton, N. J.
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Toledo Mch. & Tool Co., Toledo, O.
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Ferracute Machine Co., Bridgeton, N. J.
French Oil Mill Mchry. Co., Piqua, O.
Morgan Engineering Co., Alliance, O.
Niagara Mch. & Tool Wks., Buffalo.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.
Watson-Stillman Co., 107 Aldene Rd., Roselle, N. J.

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Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Engineering Wks., Chas. F., 222 N. Morgan St., Chicago.
Farrel-Birmingham Co., Inc., 377 Vulcan St., Buffalo, N. Y.
French Oil Mill Mchry. Co., Piqua, O.
Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago.
Lapointe Mch. Tool Co., Hudson, Mass.
Morgan Engineering Co., Alliance, O.
Niles Tool Works Co., Hamilton, O.
Northern Engineering Works, Detroit, Mich.
Watson-Stillman Co., 107 Aldene Rd., Roselle, N. J.

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Atlas Press Co., Kalamazoo, Mich.
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Lucas Machine Tool Co., Cleveland.

PRESSES, SCREW
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Schatz Mfg. Co., Poughkeepsie, N. Y.
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Niagara Mch. & Tool Wks., Buffalo.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Taylor-Shantz Co., Rochester, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.

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French Oil Mill Mchry. Co., Piqua, O.
Morgan Engineering Co., Alliance, O.
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Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Watson-Stillman Co., 107 Aldene Rd., Roselle, N. J.

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Link-Belt Co., Chicago, Ill.
Ohio Valley Pulley Works, Maysville, Ky.
Rockwood Mfg. Co., Indianapolis, Ind.

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Link-Belt Co., Chicago, Ill.

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Elmes Engineering Wks., Chas. F., 222 N. Morgan St., Chicago.
French Oil Mill Mchry. Co., Piqua, O.
Lapointe Mch. Tool Co., Hudson, Mass.
Watson-Stillman Co., 107 Aldene Rd., Roselle, N. J.

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Cleveland Punch & Shear Works Co., Cleveland, O.
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Ferracute Machine Co., Bridgeton, N. J.
Niagara Mch. & Tool Wks., Buffalo.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Watson-Stillman Co., 107 Aldene Rd., Roselle, N. J.
Wickes Bros., Saginaw, Mich.

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Hoskins Mfg. Co., Detroit, Mich.
Shore Instrument & Mfg. Co., Jamaica, N. Y.

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Adams Co., Dubuque, Ia.
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Hartford Special Mchry. Co., Hartford.
Massachusetts Gear & Tool Co., 34 Nashua St., Woburn, Mass.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
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Philadelphia Gear Works, Philadelphia.
Stahl Gear & Mch. Co., Cleveland.

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Columbus Die, Tool & Mch. Co., Columbus, O.
Gammons-Holman Co., Manchester, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Red-Line Reamer Co., Millersburg, Pa.
Reiff & Nestor Co., Lykens, Pa.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.

REAMERS, ADJUSTABLE
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Red-Line Reamer Co., Millersburg, Pa.
Reiff & Nestor Co., Lykens, Pa.
Union Twist Drill Co., Athol, Mass.

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Gammons-Holman Co., Manchester, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
Reiff & Nestor Co., Lykens, Pa.
Union Twist Drill Co., Athol, Mass.

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General Electric Co., Schenectady, N. Y.

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Taylor-Winfield Corp., Warren, O.

RIVETERS, HYDRAULIC
Chambersburg Engineering Co., Chambersburg, Pa.
Morgan Engineering Co., Alliance, O.

RIVETERS, PNEUMATIC
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Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago.

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Victor Saw Works, Inc., Middletown, N. Y.

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Potter & Johnston Mch. Co., Pawtucket, R. I.
Rivett Lathe & Grinder Corp., Brighton, Boston, Mass.

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Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
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Standard Pressed Steel Co., Jenkintown, Pa.

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Hanson-Whitney Mch. Co., Hartford.

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Consolidated Mch. Tool Corp. of America, Rochester, N. Y.
Ferracute Machine Co., Bridgeton, N. J.
Morgan Engineering Co., Alliance, O.
Niagara Mch. & Tool Wks., Buffalo.
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Niagara Mch. & Tool Wks., Buffalo.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Toledo Mch. Tool Co., Toledo, O.
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Niagara Mch. & Tool Wks., Buffalo.
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SHELVING
See Furniture, Shop.

SHERARDIZING, ELECTRIC
General Electric Co., Schenectady, N. Y.

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Morgan Engineering Co., Alliance, O.
National Acme Co., Cleveland.
National Machinery Co., Tiffin, O.
National Tool Co., Cleveland.
Niagara Mch. & Tool Wks., Buffalo.
Niles Tool Works Co., Hamilton, Ohio.
Ruthman Machinery Co., 530 E. Front St., Cincinnati, O.
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Shuster, F. B., Co., New Haven, Conn.
Taylor-Shantz Co., Rochester, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
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Grant Gear Works, Inc., Boston, Mass.
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Morse Chain Co., Ithaca, N. Y.
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Ferguson Gear Co., Gastonia, North Carolina.
Grant Gear Works, Inc., Boston, Mass.
Link-Belt Co., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia.
Ramsey Chain Co., Inc., 1039 Broadway, Albany, N. Y.
Whitney Mfg. Co., Hartford, Conn.

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Grant Gear Works, Inc., Boston, Mass.
Hartford Special Mchry. Co., Hartford, Conn.
Link-Belt Co., Chicago, Ill.
Massachusetts Gear & Tool Co., 34 Nashua St., Woburn, Mass.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
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Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.

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Union Drawn Steel Co., Beaver Falls, Pa.

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Roebling's, John A., Sons Co., Trenton, N. J.

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Morse Twist Drill & Mch. Co., New Bedford, Mass.

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Norton Co., Worcester, Mass.

STOOLS AND CHAIRS, STEEL
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Errington Mechanical Laboratory, 200 Broadway, N. Y.
Ettco Tool Co., Inc., 600 Johnson Ave., Brooklyn, N. Y.
Geometric Tool Co., New Haven, Conn.
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Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.

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Armstrong-Blum Mfg. Co., 343 N. Francisco Ave., Chicago.
Avey Drilling Machine Co., Cincinnati.
Baker Bros., Inc., Toledo, O.
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence.
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Langelier Mfg. Co., Providence, R. I.
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Morse Twist Drill & Mch. Co., New Bedford, Mass.
Murchey Mch. & Tool Co., 951 Porter St., Detroit.
National Acme Co., Cleveland.
Reiff & Nestor Co., Lykens, Pa.
Standard Tool Co., Cleveland.

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Eastern Mch. Screw Corp., New Haven.
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Ferner, R. Y., Co., Washington, D. C.
Geometric Tool Co., New Haven, Conn.
Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.
Hall Planetary Co., Philadelphia.
H & G Wks., Eastern Mch. Screw Corp., New Haven, Conn.
Landis Mch. Co., Inc., Waynesboro, Pa.
Murchey Mch. & Tool Co., 951 Porter St., Detroit.
National Machinery Co., Tiffin, O.
Rivett Lathe & Grinder Corp., Brighton, Boston, Mass.

THREAD CUTTING TOOLS
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Ready Tool Co., Bridgeport, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston, Mass.

THREAD GAGES
See Gages, Thread.

THREAD MILLING MACHINES
Adams Co., Dubuque, Ia.
Hall Planetary Co., Philadelphia.
Hanson-Whitney Mch. Co., Hartford.
Waltham Mch. Wks., Waltham, Mass.

THREAD ROLLING MACHINES
National Machinery Co., Tiffin, O.

THREAD ROLLING MACHINES, SHEET METAL
V & O Press Co., Hudson, N. Y.

TIN AND TERNE PLATES
American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh.

TOOL BITS, HIGH SPEED STEEL
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.

TOOL HOLDERS
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Lovejoy Tool Co., Inc., Springfield, Vt.
Osgood, J. L., Mchry. & Tool Co., Inc., Buffalo, N. Y.
Ready Tool Co., Bridgeport, Conn.

TOOLS, LATHE, SHAPER AND PLANER
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Lovejoy Tool Co., Inc., Springfield, Vt.
Ready Tool Co., Bridgeport, Conn.

TRANSMISSION MACHINERY
See Hangers, Shafting, Pulleys, Clutches, Couplings, Belting, Chains, etc.

TRANSMISSION, VARIABLE SPEED
Link-Belt Co., Chicago, Ill.
Reeves Pulley Co., Columbus, Ind.

TUBE EXPANDERS
Watson-Stillman Co., 107 Aldene Rd., Roselle, N. J.

TUBE FLANGING MACHINES
Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.

TUBING, BRASS, COPPER AND BRONZE
Revere Copper and Brass, Inc., 230 Park Ave., New York City.

TUBING, STEEL AND SEAMLESS STEEL
National Tube Co., Pittsburgh, Pa.
Timken Roller Bearing Co., Canton, O.

TUMBLING BARRELS
Baird Mch. Co., Bridgeport, Conn.
Hartford Steel Ball Co., Hartford, Ct.

TURRET LATHES, VERTICAL
Niles Tool Works Co., Hamilton, Ohio.

TWIST DRILLS
See Drills, Twist.

UNIVERSAL JOINTS
Boston Gear Works Sales Co., North Quincy, Mass.

VALVE LEATHERS
Chicago Rawhide Mfg. Co., 1302 Elston Ave., Chicago.

VALVES, HYDRAULIC
Elmes Engineering Wks., Chas. F., 222 N. Morgan St., Chicago.
French Oil Mill Mchry. Co., Piqua, O.
Watson-Stillman Co., 107 Aldene Rd., Roselle, N. J.

VISES, BENCH
Avey Drilling Machine Co., Cincinnati.

VISES AND CLAMPING DEVICES, AIR-OPERATED
Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago.

VISES, MACHINE
Armstrong-Blum Mfg. Co., 343 N. Francisco Ave., Chicago.
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Avey Drilling Machine Co., Cincinnati.
Graham Mfg. Co., Providence, R. I.
Purvis, Edw., & Sons, 110 York St., Brooklyn, N. Y.
Whitney Mfg. Co., Hartford, Conn.

VISES, PIPE
Greenfield Tap & Die Corp., Greenfield, Mass.

VISES, PLANER AND SHAPER
Graham Mfg. Co., Providence, R. I.

VISES, UNIVERSAL MACHINE
Brown & Sharpe Mfg. Co., Providence.

VOLTMETERS
General Electric Co., Schenectady, N. Y.

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Felters Co., Inc., Boston, Mass.
National Machinery Co., Tiffin, O.

WASHERS, NON-METALLIC
Chicago Rawhide Mfg. Co., 1302 Elston Ave., Chicago.

WASTE AND WIPING CLOTHS RECLAIMERS
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WELDING AND CUTTING, JOB
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Taylor-Winfield Corp., Warren, O.

WELDING EQUIPMENT, ELECTRIC ARC
General Electric Co., Schenectady, N. Y.
Lincoln Electric Co., Cleveland, O.
Master Electric Co., Dayton, O.

WELDING MACHINES, ELECTRIC BUTT
Federal Mch. & Welder Co., Warren, O.
Taylor-Winfield Corp., Warren, O.

WELDING MACHINES, ELECTRIC SPOT
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Federal Mch. & Welder Co., Warren, O.
Taylor-Winfield Corp., Warren, O.

WELDING RODS
Revere Copper and Brass, Inc., 230 Park Ave., New York City.

WHEELS, STEEL, R. R. AND INDUSTRIAL
Carnegie Steel Co., Pittsburgh, Pa.

WIRE, FLAT AND ROPE
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WIRE-NAIL MACHINERY
National Machinery Co., Tiffin, O.

WIRE STRAIGHTENERS AND CUTTERS, AUTOMATIC
Shuster, F. B., Co., New Haven, Conn.

WIRE WORKING MACHINERY
Baird Mch. Co., Bridgeport, Conn.
Shuster, F. B., Co., New Haven, Conn.

WRENCHES
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Standard Tool Co., Cleveland.

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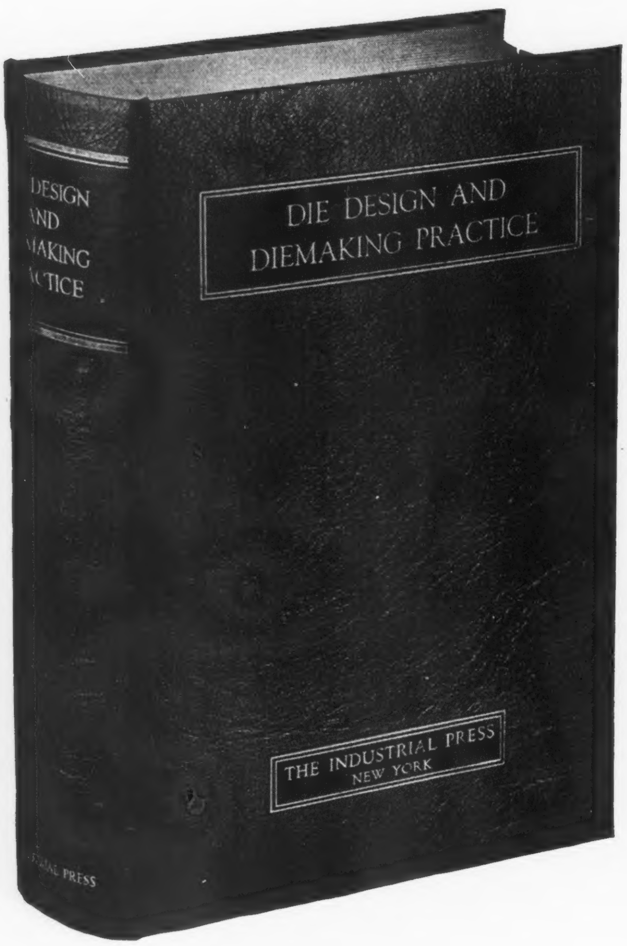

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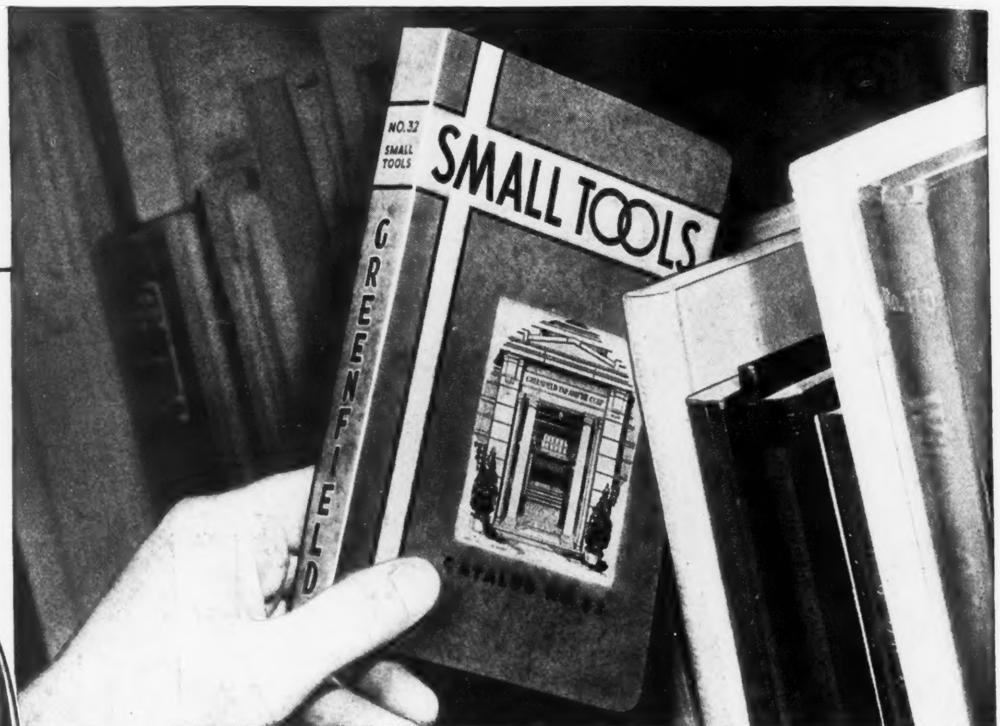

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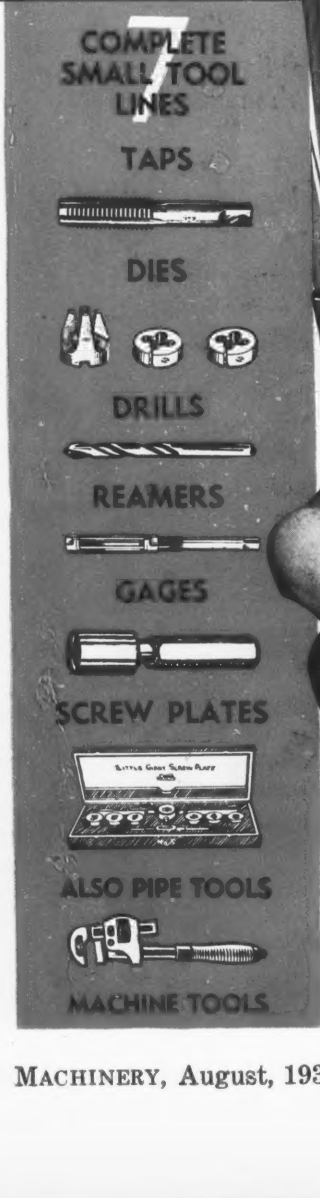

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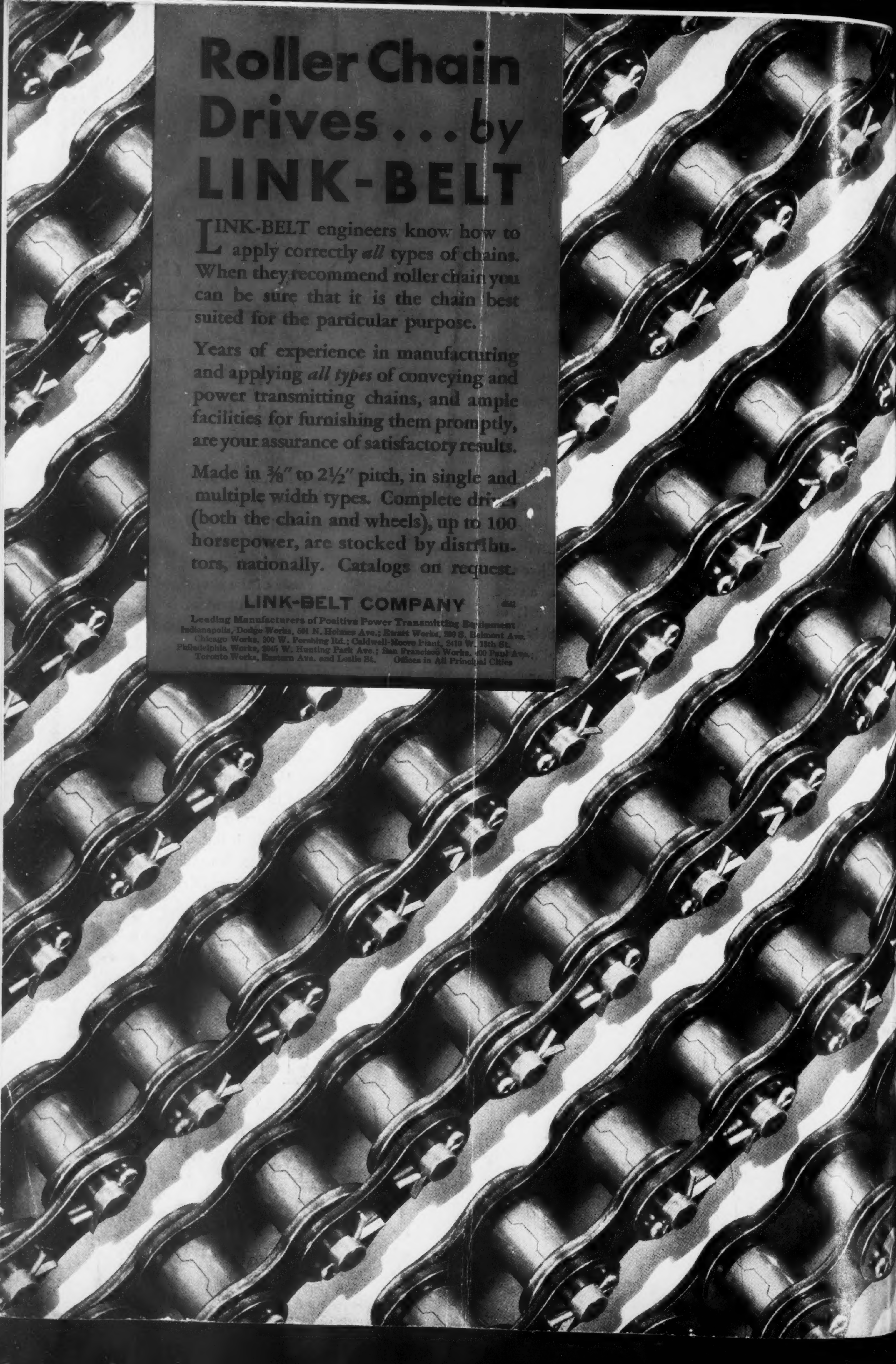

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